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THE GENERAL ELECTRIC REPORT.

Last week a brief abstract was given in these pages of the annual report of the General Electric Company, and on page 740 we supplement those data with further statistics of interest to everyone connected with the development of electrical industries in the United States. Evidence as to the rapid extension of electrical production and the large share of it due to the company is shown by the fact that the amount billed has increased over 50 per cent from the figure of 1900; in other words, the amount has risen from slightly over $22,000,000 to $36,685,000. Great as this may seem, and undoubtedly is, it is interesting to note that it is barely 25 per cent. of the total annual product of electrical apparatus and supplies in this country, the amount reaching without question between $140,000,000 and $150,000,000. At the same time the fact remains that in its own chosen fields of effort the figures of the company are largely preponderant. In spite of active competition, the net profits shown on this business reached over $10,000,000, while the conservatism of the management is indicated by the fact that only about a quarter of this was paid out in the shape of dividends.

The question often arises as to the extent to which the electrical industries can maintain the rate of development exhibited by such a report, but if the subject is seriously studied, it will be agreed that there is no department of the art in which a steady growth is not to be anticipated, even should trade slacken, and through periods of depression. The fact is undeniable that the supercession of other methods by electricity has not yet gone far. It is not to be forgotten, for example, that in the census year less than 5 per cent. of the power in manufacturing establishments in this country was electrical, and here alone is a field of enormous and indefinite consuming ability for generators and motors, as well as for lights. As to electric traction, while it might seem that most of the large cities were pretty well filled up with trolley cars, a little further investigation would show that there is not a city in the United States where the rolling stock could not well be doubled in capacity without very great relief to the congested conditions. As to the heavier work that is looming up, such as that outlined by the New York Central and the Pennsylvania Railroads, it is simply infinite in its scope, and the chief thing to be desired is that it will not come all of a rush. Telephony is in a splendid state of growth, but is still far from having reached the completed period where normal rates of increase would begin to apply; and telegraphy is certainly in a state of underdevelopment.

All things considered and looking the field over broadly, we regard the General Electric report as a splendid indication of the possibilities embraced in the electrical arts, and in saying this we take the opportunity of congratulating the officials upon the clearness, fulness and minute detail of the statement. There was a time when the General Electric report was not a particularly copious or illuminating document. To-day we think it can be held up as an exemplar for every large corporation in the industrial world.

EXPORT TRADE AND ST. LOUIS.

The fact that the St. Louis Exposition is to be dedicated this week under favorable and promising circumstances gives special emphasis to the efforts which are now being made to induce the other civilized countries of the world to participate in the great show to be held next year. It is particularly hoped that foreign man-

ufacturers and engineers will be numerously represented among us in 1904; and, as our readers are aware, special efforts are being made to organize congresses whose work shall have a lasting value. Already our English friends of the Institution of Electrical Engineers have notified their intention to participate, and if a programme of sufficient importance is laid out, we have no doubt that other countries and other engineering bodies will give official recognition to this part of the work. So far as manufactures are concerned, it may be well to point out that high as some items in our tariff may be, and strenuously as Americans may be pushing forward export trade, there remains and always will remain in this country a very large market for the productions of other countries. In the admirable speech of the Prince of Wales this week to the British Commission, of which he is chairman, the remark was made, "It should, however, be remembered that there is a considerable market for high-class goods in the United States, and also that the exhibition will afford an opportunity for showing our manufactures to customers in South America, Canada and other countries." This is an enlightened way of looking at it and is confirmed by the remarkable figures which appear in our commercial columns from time to time, showing the great and growing bulk of our importations.

Looking at the other aspect of the St. Louis Exposition, there is good reason to hope and believe that the assemblage of the best American fabrics, machinery, etc., will serve to develop a new demand for them in various parts of the world which they have not hitherto reached or where they are not adequately known. The population of the world is growing, the wealth of the world is increasing, the interchange of products will be larger and larger as years go by, and the only way to share in the commercial intercourse is to know and be known. It is true that our own exports have been somewhat restricted by the great prosperity of the country, and Mr. Thomas A. Eddy, returning recently from South America, stated that the exportation of American manufactured goods in that region has been reduced 30 per cent. since the year 1900, owing to the fact that American prices had become high and delivery slow, while the packing of exportable articles had also been inferior, so that the goods often could not be transported in safety. But, as our own commercial columns this week show so forcibly there are possibilities for electrical and machinery export the world over.

Safety Devices in Central Stations.

The recent Institute paper of Mr. Philip Torchio, on station safety devices, though relating particularly to the systems employed in New York City, contains a number of useful rules which, while admitting of differences of opinion, will commend themselves to constructing and operating engineers generally. A moot question is the extent to which fuses should be used in a general lighting or power system. There can be no doubt of the necessity for using reliable fuses in the wires and fixtures of consumers. Unless some form of automatic cut-out is employed on the premises of the customer, there can be no security against fire. No cut-out has yet been found which is so cheap and so generally reliable as the ordinary fuse link or fuse strip. It can always be depended upon to melt when its current-carrying limit has been exceeded, although the exact limit may not always be accurately foretold. We shall print the paper next week.

The difficulty with fuses, from the station manager's standpoint, is that they may melt at an unduly low current, owing to unsuspected weakness, and thus interrupt the service. If there are, say, five sets of feeders between the central station and the load in a certain district, then, if all the feeders are adequately fused, so as to prevent them from carrying a dangerously strong current, the consequences of an accidental melting of a fuse may be serious. In such a case, the load previously carried by the feeder thrown off, is distributed among the four remaining feeders, thus tending to overload them, and bring their fuses to the danger point. If this causes another fuse to melt, the whole load will be thrown upon three feeders, and the chance of their being overloaded is rendered still greater. Cases have been known where an accident to the fuse or one feeder has soon effected the destruction of a number, thus interrupting the service.

The result of such experiences has been the abandonment of fuses outside buildings, and the solid connection of all mains and feeders through copper strips at junction boxes. If a short circuit occurs in a main or feeder, it becomes the business of the generators, with or without the assistance of a storage battery, to burn off the offending "short." This is usually preferred to the chance of accidentally cutting off conducting mains or feeders by over-sensitive fuses. As a rule, a central station can burn out any underground short-circuit without more than a momentary flicker; but in bygone days a whole central station would occasionally groan and wrestle for minutes with a distant short-circuit.

The Central Station Steam Plant.

The process of increasing the size and output capacity of central station units has steadily advanced since the inception of electric lighting. The first electric lighting dynamos were little machines of two or three horse-power that would seem like toys at the present time. As soon as the system was found to be practicable, the demand arose for a large unit in place of an equivalent aggregation of small ones. As fast as the larger unit was built, the demand for yet larger sizes outstripped it. This advance has gone on steadily, until of late the difficulty has been to get suitable steam engines of sufficient power to drive the size of dynamos which could be constructed. As pointed out by Mr. Lardner in his recent Institute paper, the largest marine engines are still more powerful than the largest engines installed in electric lighting stations. But the conditions of regulation in speed and in uniformity of rotation involved in central station operation, are more severe than in marine engines. Moreover, the cost of construction and installation in the largest sizes of engines does not show much advantage to the engineer in their adoption over existing sizes, as found in New York central stations. If any repair has to be effected in a very large engine, the delay in removing and replacing the part is apt to increase disproportionately after a certain large size of engine has been adopted.

If, however, the steam turbine proves an unqualified success, we may expect a change in the existing order of dimensions. In the first place, the sizes will be so much reduced that an engine the size of the present type of 5,000-kw will be perhaps of 20,000-kw capacity. Moreover, the simplicity of the steam turbine as compared with a reciprocating engine, should enable a turbine of that capacity to work very steadily and reliably. Unless the reliability of an engine increases at least in proportion to the size, engineers will be loth to build on a larger scale, since it means putting too many eggs in one basket. If then, the steam turbine is successful, there will be no constructive limit in the near future to the size of units. But it is doubtful, however, whether any plant at the present date would care to tie up as much as 20,000 kw in a single unit. A well-designed large central station should probably retain not less than five units, no matter how large the machines that may be economically constructed. If stations continue to grow in total capacity, we may expect to see the power divided among about five units, if there is economical advantage in the full size thus reached. There seems to be no reason why a 50,000-kw turbo-generator might not be constructed some day; but it is doubtful if such a size of reciprocating engine could be built and operated under commercially satisfactory conditions.

There can be no doubt that the increase in the size of central station units has materially reduced the cost of producing the kilowatt-hour at the switchboard, though the rate of reduction decreases as the size increases. So long as the construction is reliable, however, the cost of attendance per kilowatt diminishes steadily with the size, and promises to diminish still further with turbo-generators. The ideal large central station would have automatic stokers feeding large boilers working directly into a few large turbo-generators. The few men required would then merely have to superintend and control.

CENTRAL STATION DESIGN.

The Institute is to be congratulated on the excellent character of the papers read at the recent meeting, as well as on the strength of the following discussion. Since all members do not have general access to trade bulletins and catalogues, it may possibly be desirable to devote a meeting occasionally to papers descriptive of the latest wares in a selected branch; the success, however, of the March and April meetings indicate that the old-time Institute programme dealing with the broader questions of electrical engineering has not lost in interest to members. No small share of the credit of the success of these two meetings is due to Messrs. Ralph D. Mershon and Henry G. Stott, the former having been given charge of the programme for the transmission meeting and the latter that of the meeting on Friday of last week. As remarked by President Scott, in opening the meeting, the papers of the evening were notable in that they dealt with fundamental and broad questions of central station design, and it may be added that they reflected a shifting of engineering opinion which, though until the present receiving little or no public expression, has for sometime been apparent to those who have closely watched present-day central station conditions. In this respect the papers and discussion promise to have no small influence through directing attention generally to the fact that central station development along later lines has about run its course, and that in the case of large systems the time has arrived when account must be taken of the many new factors strongly affecting central station equipment and operation and consequently central station design.

The papers by Messrs. Junkersfeld and Lardner respectively deal from the standpoint of the practical operating engineer, with some of the difficulties which are associated with the colossal central stations which have been the fashion within the past few years. The advantages of centralization have been dinned into our ears over and over again, but after all there is something to be said for local self-government in central station operation as in politics. Mr. Junkersfeld's paper deals with some of the curious complications arising in the operation of a modern central station with its polyphase transmissions, sub-stations, batteries and switching systems. He holds, and we think correctly, that there are times when the operation of the network as a whole becomes a practical disadvantage, and the load can be worked with greater ease and safety in independent sections. This is almost self-evident when one fully grasps the nature of the network as a whole, and it is equally clear that there are times when operation as a whole is highly desirable. The point of the matter is that when trouble like a short circuit occurs, it will injuriously affect just so much of the whole system as is tributary to it. If every generator is on the same bus-bars and connected to the whole network, the voltage of the whole system will fluctuate; while if the fault be on an isolated circuit, only that circuit will suffer. The moral is that whether the normal mode of operation is as a single network or several, it should be possible to cut off and isolate a faulty section very promptly. The problem of doing this has never been properly worked out, and until it is there is something to be said for operating in sections.

The troubles to which Mr. Junkersfeld refers are undoubtedly aggravated when the system includes high-voltage transmission to sub-stations with rotaries. In case of a fault the transmission system enables enormous amounts of energy to be poured into it, which in a simple direct-current distribution would be limited by drop in the feeders and mains. But we think Mr. Junkersfeld errs in ascribing any peculiar relations in this particular to synchronous operation as such. The real trouble is that the very characteristics that enable the system or any systems to run with small loss in the distribution render faults the more disastrous. To an alternating transmission system all faults act as if they were close to the station, and that is all there is to it. The central station manager is perpetually between the devil and the deep sea—if his distribution is highly efficient and gives the best of regulation when in perfect order, it will be subject to specially violent and destructive action when anything goes wrong. And incidentally the concentration of the generating units involves some danger of a single accident involving a large part of the total plant capacity. Of course, a system of partition walls and remotely controlled valves and switches lessens this danger, but it also greatly reduces the incentive to centralization. By the time a huge plant is thus subdivided, from an operative standpoint it may, and in our judgment generally will, become quite as costly to build and to operate as if its units were grouped in several plants judiciously scattered over the load area. And if as sometimes happens, the colossus is reinforced by prime-movers installed at some of the sub-stations, the safety precautions are a confession of defeat.

And this brings us to Mr. Lardner's paper. Mr. Lardner points out very clearly both the dangers of putting all one's eggs in one basket, and the uselessness of the procedure after the number of eggs becomes large. It is all very well to advise watching the basket, but the point has been already reached where the necessary amount of watching can be just as effectively distributed between several baskets. It is often urged that by building a single station, the best point with respect to coal and water supply can be utilized; but when the cost of transmission is considered, and the system is designed for minimum cost of energy at the center of load, the case takes on a very different aspect. It is true that very large generating units secure a certain amount of economy in first cost and operation. If, however, the plant be reckoned on the basis of first cost and final cost per kilowatt-hour delivered at the center of distribution, as we have just suggested, the very large units may not appear to so great advantage. Taking for instance Mr. Lardner's figures for guaranteed steam per kilowatt-hour in steam turbines, and we find that the gain in passing from 500 kw to 5,000 kw in size is not enough to equal the losses in transformers and feeders to the sub-stations of a transmission plant. As between a 1,500-kw and a 5,000-kw size, the gain in steam consumption will barely balance the energy lost in the transformers alone. Of course, the floor space may be better utilized in the larger unit, but the difference amounts to only a small fraction of a square foot per kilowatt capacity. There is only one great system in this country, that of the Boston Elevated Railway Company, which has systematically held to separate stations of moderate capacity. Its power expense has never been fully made public, but we are very strongly of the opinion that it will compare favorably with the costs obtained in the huge stations erected elsewhere. It takes a large gain from concentration to offset the losses in distribution to sub-stations, and the operating expenses and cost of the latter. When all these things are taken into consideration, we think the station of maximum economy will be of much less output than has sometimes been supposed. The subject is one that needs investigation on its merits—it cannot be settled on purely hypothetical data.

Annual Report of the General Electric Company.

Last week we presented a brief abstract of the annual report of the General Electric Company, issued on Wednesday. We can now supplement that data with some further figures from the interesting statements of President Coffin and his associates. As noted last week, the report shows gross sales of well over $36,000,000, net profits of $10,277,169, and dividends paid of $2,721,594, altogether a splendid manifestation of the possibilities of well-directed industry in the electrical field.

The balance sheet as of January 31, 1903, compares as follows:

Assets:	1903.	1902.	1901.
Patents	$2,000,000	$2,000,000	$2,000,000
Plants	5,000,000	4,000,000	3,400,002
Real estate	431,456	464,195	522,453
Stocks and bonds	12,682,215	9,825,820	6,012,300
Accounts receivable	12,816,608	11,364,345	9,596,940
Inventories	11,561,216	8,876,883	7,990,980
Work in progress	1,769,456	1,338,258	1,054,650
Cash	3,632,556	4,058,448	2,373,683
Total	$49,893,507	$41,927,251	$32,951,017
Liabilities:	1903.	1902.	1901.
Common stock	$41,880,733	$24,910,900	$21,400,300
Preferred stock	.....	.....	2,551,200
Debentures	2,148,400	372,000	1,534,000
Accrued interest	825	3,100	16,533
Accounts payable	1,378,961	1,349,335	820,450
Unclaimed dividends	1,886	4.775	.....
Profit and loss surplus	4.482,702	15,287,140	6,628,534
Total	$49.893,507	$41,927,251	$32,951,017

The income account of the General Electric Company for the past four years compares as follows:

	1903.	1902.	1901.	1900.
Net profits	$10,277,169	$8,598,241	$6,243,792	$5,479,131
Dividends and interest	2,721,594	1,997,966	1,968,289	1,282,670
Balance	7,555,575	6,600,274	4,275,502	4,196,461
Pat. acct. Sprague Elec. Co.	1,613,879	.....	.....	.....
Balance	5,941,696	6,600,274	4,275,502	4,196,461
Inc. val. sec.	.....	2,057,685	.....	.....
Total	5,941,696	8,657,960	4,275,502	4,196,461
Previous surplus	15,287,140	6,629,180	2,353,030	156,570
Total surplus	21,228,835	15,287,140	6,629,180	*2,353,030
Stock issued	16,746,133	.....	.....	.....
Surplus	4.482,701	15,287,140	6,629,180	2,353,030

* $2,000,000 written off.

The various sources from which profit were derived compare for the past four years as follows:

Sales	$36,685,598	$32,338,036	$28,783,276	$22,379,463
Royalties	814,958	141,391	298,366	868,706
Dividends	393,961	434,350	232,041	309,428
Profits on sales st'ks & bds	973,649	938,584	419,067	838,857
Inc. val. sec.	.....	2,057,685	.....	.....
Interest and discount	253,882	.....	96,902	70,710
Total	$39,122,050	$35,910,049	$29,829,652	$24,406,068
Cost of sales	28,844,881	25,254,122	23,585,860	18,926,937
Net profit	$10,277,169	$10,655,927	$6,243,792	$5,479,131

A comparison of the balance sheet as of January 31, 1903, with the three preceding years, follows:

Assets:	1903.	1902.	1901.	1900.
Patents, franchises	$2,000,000	$2,000,000	$2,000,000	$2,000,000
Factory plants	5,000,000	4,000,000	3,400,002	3,400,002
Real estate	431,455	464,195	522,453	563,643
Stocks and bonds	12,682,214	9,825,120	6,012,300	6,132,268
Accounts received	12,816,607	11,364,345	9,596,940	6,978,002
Inventories	11,561,216	8,876,883	7,990,980	8,047,581
Work in progress	1,769,456	1,338,258	1,054,659	874,128
Cash	3,632,556	4,058,448	2,373,683	1,537,072
Total	$49,893,507	$41,927,251	$32,951,017	$29,532,697
Common stock	$41,880,733	$24,910,900	$21,400,300	$18,276,000
Preferred stock	.....	.....	2,551,200	2,551,200
Debentures	2,148,400	372,000	1,534,000	5,300,000
Accrued interest	825	3,100	16,533	44,166
Accounts payable	1,380,846	1,354,110	820,450	1,008,299
Profit and loss surplus	4,482,701	15,287,140	6,628,534	2,353,030
Total	$49,893,507	$41,927,251	$32,951,017	$29,532,697

The amounts written off factory plant and patent accounts exceed the amounts written off those accounts last year by about $2,500,000. The present condition of the business of the company is satisfactory and indicates a considerable increase in volume for the current year over that of last. The total sales (amount billed to customers) during the past year were $36,685,598. The yearly orders and sales for the past four years are as follows:

Year ending Jan. 31	Amt. billed.	Orders rec'd.	Yearly inc. of Orders rec'd.
1900	$22,379,463	$26,323,626	51.1%
1901	28,783,275	27,969,541	6.3%
1902	32,338,036	34,350,840	22.7%
1903	36,685,598	39,944,454	16.4%

Since February 1, 1900, the reported orders received have not included the times of service of experts and labor, freight and transportation, supply material, boilers, engines, etc., of outside manufacture and bare copper wire, which items were included prior to 1900. These items amounted to $1,558,371 during the past year. Including these items the total orders received for 1902 aggregate $41,502,825.

With regard to the acquisition of the Sprague Electric Company, the following reference is made by vice-president General Eugene Griffin: "By the purchase of the Sprague patents we have come into possession of the only fundamental and detailed patents, outside of those already owned by our company, covering a successful and satisfactory form of multiple-unit control. This system, now known as the Sprague-General Electric System, is in successful operation on many roads." A list is given of 31 roads with 2,081 cars on which the multiple-unit system has already been adopted.

General Griffin also remarks: "My report of June 28, 1897, states: 'Since the organization of the company in 1892, we have sold 30,912 railway motors, having a total capacity of 795,120 hp. Since that date we have sold 54,344 motors, having a total capacity of 2,304,986 hp. The grand total of railway motor sales in the past eleven years is 85,256 motors, having a total capacity of 3,100,106 hp. These motors are in operation in all parts of the world. The growth of water power enterprises is shown by the fact that 221 plants are now in operation with 428,269 hp in General Electric generators. We received about 162,000 separate orders during the year (not including contracts), an average of 541 per day.'"

Vice-president E. W. Rice, Jr., in his report, says: Expenditures aggregating about $2,500,000, exclusive of the cost of patterns, small tools, etc., have been made during the year for real estate, extensions to existing buildings and the erection of new ones, and for additional machinery; all required to take care of the increased business. The following table shows approximately the increase in floor space and in the number of employees during the past five years:

	Factory floor space in square feet.	Factory Employees.
1899	1,800,000	8,000
1900	2,000,000	11,000
1901	2,300,000	12,000
1902	2,500,000	15,000
1903	3,000,000	18,000

As to electric drive, Mr. Rice states that such applications by the General Electric Company show an increase of 40 per cent. in 1902. As to mining work, he mentions one coal company that operates some 50 General Electric locomotives over some 200 miles of track, mostly underground. As to methods of generation and distribution, Mr. Rice says: "The demand for direct-current generators of large size, 2,000 kw and over, has fallen off. This has been due to the increasing use of alternating current in the generating station and its conversion, where needed, into direct current at sub-stations through the medium of rotary converters. This system, which has been mentioned in previous reports, has now become standard for all large undertakings in this country and is being rapidly introduced abroad. Its great economy and flexibility has undoubtedly contributed largely to the successful and extended use of electricity for all purposes. It is interesting to note that the capacity of some of these sub-stations is much greater than that of the largest generating stations that were in existence a few years ago."

The company reports some 14,500 regular customers on its books.

New York Lighting Plant.

The proposal to establish a municipal lighting plant for New York City has been lost in both the Senate and Assembly, so that the scheme is dead, or at least in abeyance, for the present. The proposition received wide attention.

The New Brussels Telephone Exchange.

OWING to the continuous increase in the number of subscribers and the necessity of reducing to a minimum the cost of operation, the Belgian Government some time since appointed a commission to investigate the several modern telephone systems and designate that which they considered the best. The transformation of a telephone system is a matter of very large cost, and in this case the decision involved the telephone service of the entire kingdom. After having visited most of the countries of

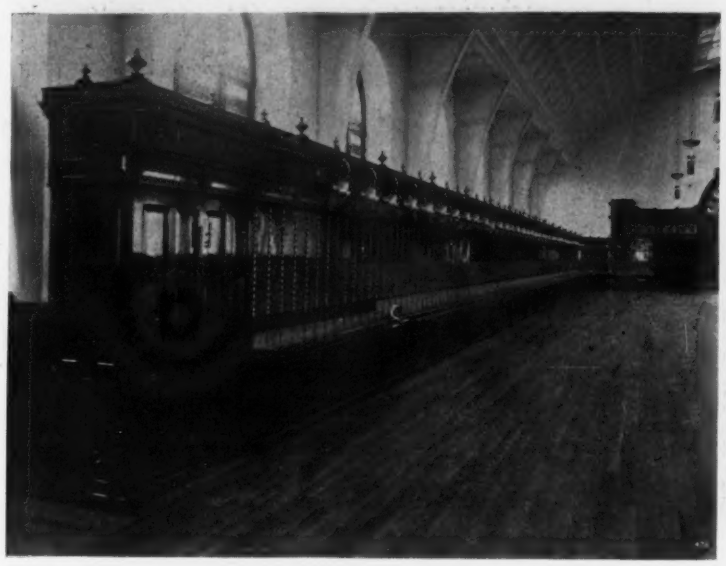


FIG. 1.—GENERAL VIEW BRUSSELS EXCHANGE.

Europe and America and giving the most careful thought to the subject, the commission made the following recommendation:

All grounded circuits should be transformed to metallic circuits and in large cities the conductors be placed underground. The common battery system should be adopted and new exchanges be so constructed as to provide so far as possible for the growth of the service, and assure the comfort and health of the personnel.

It was in accordance with this recommendation of the committee

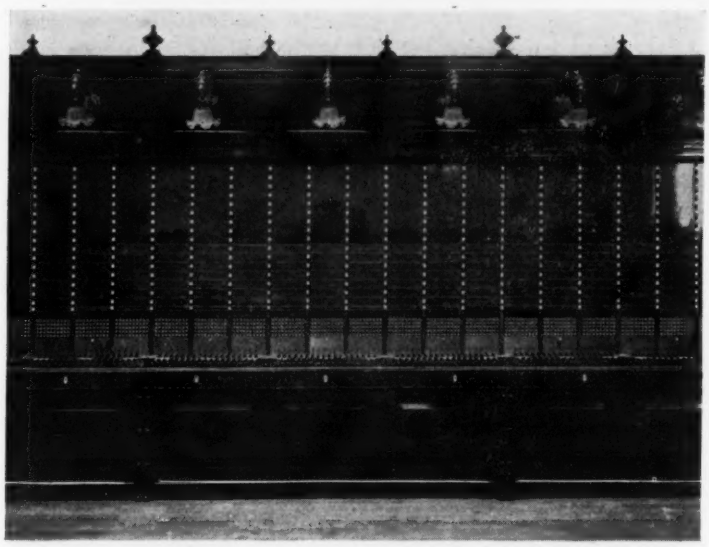


FIG. 2.—SECTION OF SWITCHBOARD.

that the new central exchange at Brussels was designed, a description of which follows.

The building is 197 ft. long, 65 ft. wide, and is 106 ft. high, measured from the street level. It comprises a basement at the level of an interior court and four stories. The third, or principal story, is entirely reserved for the operating room, which is 33 ft. high in the middle and 26 ft. high at the walls. This room, a view of which is given in Fig. 1, is both light and airy, thus conducing both to the health of the employees and the quality of the service. At the left of the hall is the multiple switchboard, which is equipped for 6,300 subscribers and 43 operators, its total final capacity being for 14,400 subscribers.

Fig. 2 shows the last section of the board for three operators' positions, there being nine panels of jacks in a length of 6 ft. Fig. 3 gives a view behind the board, the shutters being removed. This shows the disposition of the general jack cables and the supervising relays which control small lamps in connection with 17 pairs of plugs for each operator's position. All the parts of the switchboard are very accessible, and, moreover, offer no difficulty in making extensions, which can be provided for without in any manner interfering with the existing sections and the service. The cables from the intermediate distributing board, which serve local jacks,

FIG. 3.—REAR VIEW OF SWITCHBOARD.

are in a channel immediately behind the board; the successive groups of these cables for each operator's position pass through small openings in the floor underneath the supervising relays. These groups of cables then pass vertically between two successive groups of supervising relays to the corresponding local jacks.

Fig. 4 gives a view of the interurban tables. A calculagraph is placed between each two adjacent operators for the automatic stamping on the tickets of the time of the commencement and close of each interurban connection. The night service can, by means

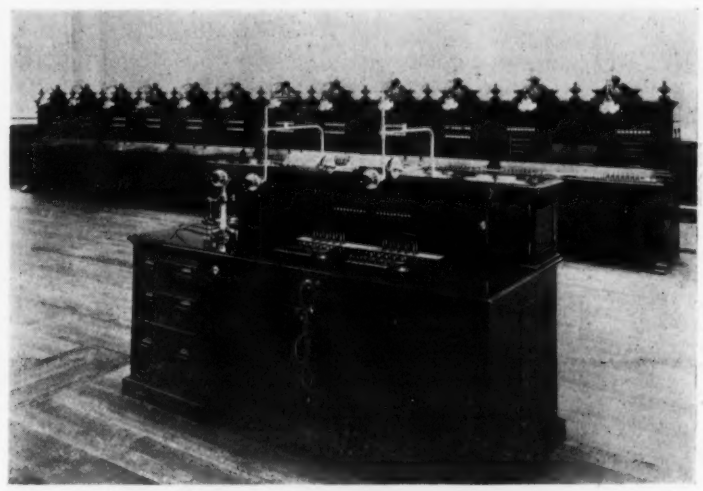


FIG. 4.—INTERURBAN SWITCHBOARD AND TOLL TABLE.

of a simple commutator, be entirely switched on to the last section to the right of the interurban board.

The employees at this table receive all calls for interurban connection and prepare the tickets relating thereto. The auxiliary lines which connect the interurban and local service are provided with automatic signals represented by small lamps, which system permits the reduction to a minimum of the manipulations for connections and at the same time facilitates supervision.

Very complete means are provided for protection against fire, both with respect to security to the personnel in case of actual fire and in preventive means. Of all these, the best and at the same time the least expensive, is that furnished by protective fuses and light-

ning arresters, which are placed on the intermediate distributing board in the story below the operating room. The exterior lines entering the exchange offer the greatest hazard from fire, and in the new exchange each line aerial or underground is provided with a lightning arrester so adjusted as to protect the wiring and apparatus of the multiple switchboard.

The cables, which are paper insulated and lead encased, are carried from where they enter the building in a wall channel to the

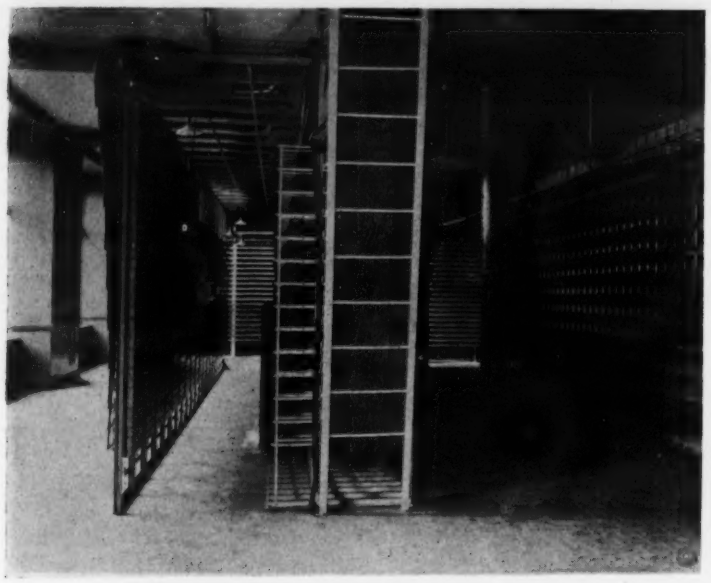


FIG. 5.—CABLE LEADS AND DISTRIBUTORS.

second floor, where they terminate in cable heads, from which the interior cables start, as shown in Fig. 5. This principal distributing board is shown to the right of Fig. 5, the center of which is occupied by the intermediate distributing board; to the left are the calling relays and in the background the translator board. Fig. 6 shows in the background the details of the latter. Figs. 5 and 6 together enable an idea to be obtained of the connecting cables which unite these boards together and with the switchboard. The cables are carefully disposed in a simple order, and there are no crossings.

The second story also contains the plant furnishing current for

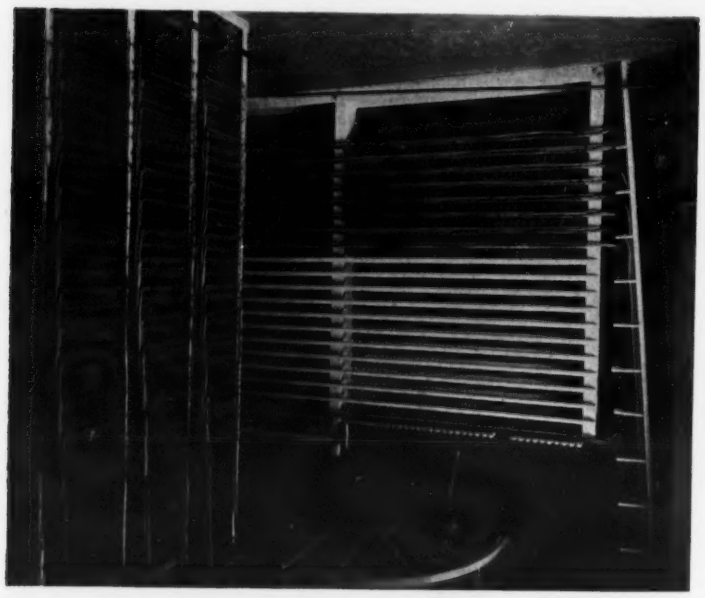


FIG. 6.—REAR OF DISTRIBUTING BOARD.

the common battery system, including a storage battery of eleven cells, a portion of which is shown in Fig. 8. The 110-voltage current required for operating the two motor-generators may be obtained from the street service or supplied by two gas engine units in the basement. The 110-volt current is transformed to 24 volts for charging the storage battery, the capacity of which is sufficient to operate the exchange for 24 hours. One of the motor-generators is kept in reserve. The motor-generators have been so designed with such care that it is possible to charge the accumulator during the hours of service without affecting in the slightest the service at either the switchboard or at the subscriber's telephone. Should an accident happen to the storage battery, it is even possible to supply the service directly from the motor-generator, and it is for this reason that there is no reserve storage battery. The generators supplying calling current are shown in Fig. 7 to the right of the motor-generators; two of these are installed, one being in reserve.

FIG. 7.—GENERATING PLANT.

The first calling generator is operated by current from the storage battery, while the second is connected with the street circuit. The secondary current furnished by these generators is an alternating current of 75 volts. The generating apparatus shown in Figs. 6 and 7 supplies all the electrical energy for the entire service of Brussels, not only for calling and the operation of all signals, but for the transmission of speech.

The second story contains also all the apparatus which plays an intermediate rôle between the exterior circuits and the switchboard on the third floor. On this floor also is concentrated the trouble-finding and testing service. Owing to the use of the intermediate independent distributing board, faults may be quickly located and repaired.

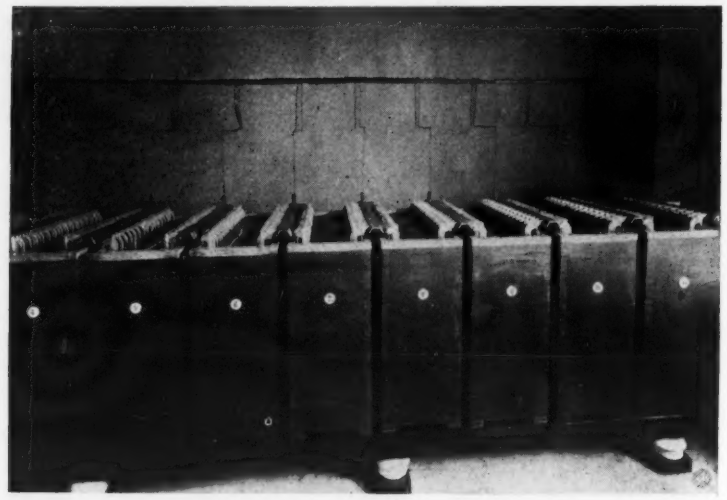
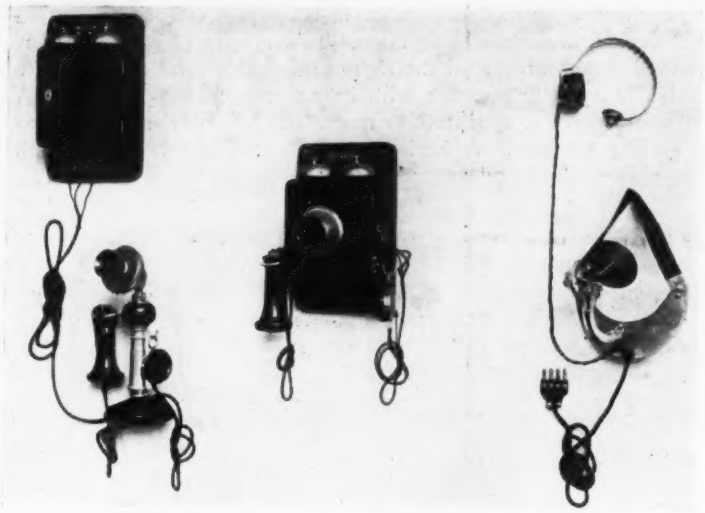


FIG. 8.—STORAGE BATTERY PLANT.

The other stories of the building are assigned to the several departments of the State Telegraph administration. In the cellar are the gas engine generating sets, the apparatus for heating and ventilation, etc. A high-speed elevator is at the service of the operators, and on the upper floor are a number of rooms for their convenience, including cloak rooms, library and reading rooms, baths, and kitchen, which latter supplies at cost meals to the personnel. There is also a doctor's office and rooms are provided for

cases of illness. It is well known that the duties of operators are very trying, and it is, therefore, proper that their comfort should be thus provided for. The new switchboard adopted is, however, a great advantage in their work and reduces to a minimum the number of words to be spoken to subscribers. The automatic signal system enables an operator to follow the course of a call without listening in, which latter was necessary in the system displaced. Moreover, since the operator is enabled to know the precise moment when a conversation is finished, she can immediately disconnect and thus increase considerably the efficiency of the subscribers' lines as compared with the old system. Moreover, the common battery system also lightens the subscriber's share in telephonic connection. It is only necessary for him to take his receiver off the hook in order to call, and returning it to the hook signals the close of conversation. The connection for a call can be made at once, for the operator has merely to inquire the number of the subscriber called and make calling connection with him without being obliged to wait until he answers.

Figs. 9, 10 and 11 show the types of telephone instruments that have been adopted for Belgium. Fig. 10 represents the wall type, which is extremely simple. This set consists of a solid-back transmitter, a commutating hook, two receivers, a call bell, an induction coil and a condenser. No local source of electricity is necessary,



FIGS. 9, 10 AND 11.—TYPES OF TELEPHONES.

the current for the station being supplied from the exchange. Fig. 9 shows a set which consists of two independent parts connected by a flexible cable; one part consists of a solid-back transmitter mounted on a column supporting the two receivers; the second comprises a bell, an induction coil and a condenser in a box. The apparatus for operators is shown in Fig. 11. The exchange has been equipped on the Bell system by the European interest of the Western Electric Company.

Stockton Municipal Plant Report.

A movement at Stockton, Cal., for a municipal lighting plant appears to have got a quietus from the report to the city council by Prof. C. L. Cory. He stated that with the plant contemplated, running 200 arc lights on a moonlight schedule, the engines going twenty-four hours daily and operating also the incandescent system for commercial and residence lighting, the cost to the city for each arc light per month would be $7.45. The present cost to the city per arc light monthly is $6.90. Prof. Cory explained that the plant contemplated was considerably larger than the present needs of the city demanded, but he believed it better to put in a larger plant than required at the outset than to have to add to the plant when the city grew and there was a greater demand for power. He thought the city should build with a view to the future. Prof. Cory presented plans for the lighting plant complete, with a map of the city showing the location of the poles of the distributing system, and he also presented a mass of figures and statistics regarding municipal lighting. He said the plant contemplated by his plans was the best that could be got and such a one as the city should have. The price given, moreover, was based on overhead circuits and the consumption of fuel oil at 70 cents a barrel.

Blondel Oscillograph.

BY HENRY HALE.

ONE of the striking exhibits at the 1900 Paris Electrical Congress was the Blondel oscillograph, which gives a visual representation of alternating-current waves that formerly were plotted from laborious determinations by contact methods of successive points of the curves. The latest form of that apparatus is illustrated herewith and among its practical uses is the taking of curves of alternators, motors and transformers in studies of design and operation. The arrangement is such that two different wave forms may be taken at a time, corresponding, for instance, to e.m.f. and current, and these are superposed in their relative position. The waves are thrown on a ground-glass screen about 4 by 6 in. and are traced by a spot of light. For the accomplishment of this a small iron piece is free to oscillate between the poles of a horseshoe magnet and carries a small mirror. The coil carrying the current acts upon the mirror and the latter vibrates according to the variations of the current. The small mirror sends a beam of light on to an inclined mirror, which is oscillated by a synchronous motor, and the combined action traces the wave form upon the screen, as will be further indicated.

In order to respond exactly to a wave form of a high-frequency period, it is essential that the mirror should follow the variation of the wave at every point, and the vibration period of the mirror itself must be reduced to a minimum in order that its vibrations will not conflict with the impulses it receives from the current. M. Blondel has succeeded in carrying this out by using a very narrow and thin iron band for the vibrating piece, which is stretched between two bridge-pieces, and carries a small and light mirror in the center. In this way he obtains a band whose rate of vibration is as high as 50,000 periods per second, and can thus follow the variations of even the most irregular waves. In practice the band is mounted on a support which protects it and also allows it to be adjusted with reference to the poles. This arrangement is shown in Fig. 1 on the left. The cylindrical supporting rod, *R*, has a groove running from top to bottom. In the upper part of the groove is a sliding piece, *S*, which may be regulated by the milled nut, *N*, at the top. The vibrating band, *B*, is attached to a bridge, *b*, below, and above to the end of the sliding piece at *a*. By turning the screw the band, carrying the mirror, *M*, is given the necessary tension. The rod carrying the mirror is mounted in an outer protecting tube, *T*, which is filled with oil to prevent the oxidation of the band. The tube has an opening, *O*, opposite the mirror, carrying a lens; the two soft iron pieces, *I*, are inserted in the tube to concentrate the magnetic effect of the poles upon the band at this point. The upper milled screw, A, allows the tube to be turned in its support so as to adjust the mirror.

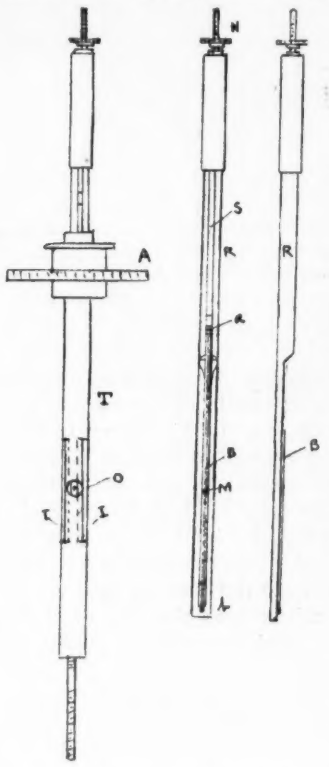
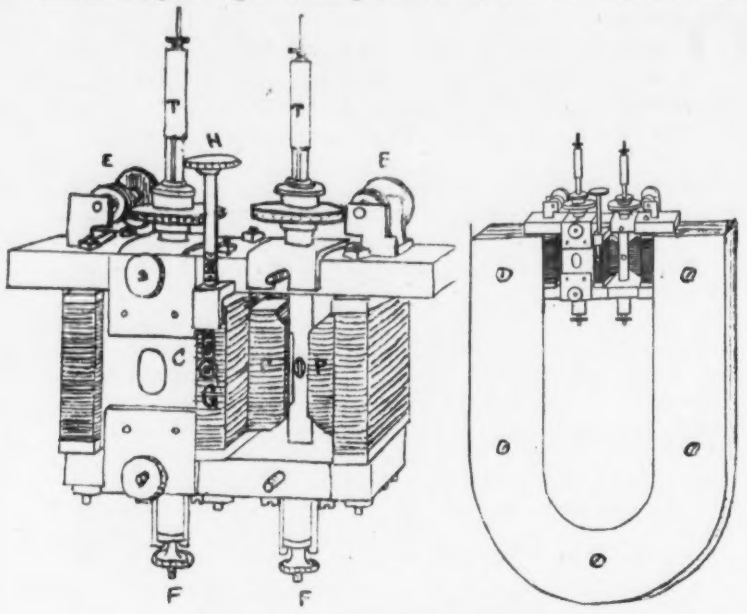


FIG. 1.—BLONDEL OSCILLOGRAPH.

The vibrating band is mounted so as to bring it between the poles of a powerful horseshoe magnet. In practice there are two bands, forming a double oscillograph, which are inserted between the poles of an inverted horseshoe as will be noticed on the left of the general view. The double form is useful in taking current and e.m.f. waves at the same time. The tubes, *T*, are mounted, as shown in Fig. 2, between the laminated pole pieces, *P*, which are inserted between the poles of the magnet and form a compact ensemble. The current whose wave form is to be taken is sent into a coil of fine wire or flat strip which is inserted at *C* on each side of the pole pieces, *P P*; the coil has an opening in the center to allow the light to fall on the mirror. The tube is adjusted horizontally by the endless screw, *E*, which turns it about, and by the lower screw, *F*, which

slides it up and down. In the center is a small mirror, *G*, adjusted by the screw, *H*, which gives the permanent strip of light forming the zero line of the curves. The



FIGS. 2 AND 2A.—OSCILLOGRAPH.

vibrating band has proved far superior to the system of pivots or wire suspension. Owing to the effect of torsional vibration the oscillating period is very high and is still further increased by the tension and the strength of the magnetic field. The number of vibrations proper to the band is in fact the square root of the sum of the squares of the numbers of vibration due respectively to the elasticity of torsion, to the tension and to the magnetic field. Experiment has shown that the band works best when it is saturated, and it is for this purpose that the magnetic field is concentrated as much as possible. It is also very sensitive to the influence of the current in the coil, as the effect accumulates from the ends toward the middle. The iron band is made as small as possible and is now only 0.03 in. wide and 0.002 thick; the mirror which it carries is correspondingly small, being 0.01 in. wide, 0.02 high and from 0.005 to 0.003 thick. It is made of thin glass or mica, which is silvered by deposition from a bath and is attached to the band by shellac.

The variable wave traversing the coils causes the spot of light reflected from the mirror to vibrate to and fro with an amplitude corresponding to the intensity of the current. To produce the wave form the spot must be displaced in a direction perpendicular to the former and proportionally to the time of vibration. For this the spot is reflected from an oscillating mirror placed at 45°, which is operated by a small synchronous motor. The method of mounting is shown in Fig. 3, where *O* is the oscillograph mirror which receives light from a source, *A*, through the lens, *B*. From the mirror the light is reflected through the lens, *C*, upon the oscillating mirror, *M*, and thence to the ground-glass screen, *S*, above, where it is concentrated to a point. The mirror is made to oscillate by a cam, *D*, on the shaft of a small synchronous motor; the cam has a profile adapted to give a uniform movement of the image on the screen during the forward stroke of the mirror, which is proportional to the wave period, and then allows it to drop back quickly so as to recommence the forward stroke. The formation of the wave under these conditions is easily understood. A small fixed mirror between the two oscillographs sends a spot of light on the oscillating mirror and the continuous image of this spot forms a straight line from right to left for the base-line of the wave. The oscillograph mirror under the action of the current would, if acting alone, cause the spot to oscillate across the base line at an equal distance on each side, forming a straight line, but the oscillating mirror distributes the light from the spot in a direction parallel to the base line, so as to form a continuous wave. In practice the oscillating mirror swings on the forward stroke so as to allow the spot to form two complete waves. At the end of the period the cam causes the return or back stroke, which takes place very quickly, and during this period the light is cut off by an electrically-operated shutter, *E*, placed in front of the light. The eye does not perceive this movement.

The lens, *C*, is of semi-cylindrical form and thus the rays coming from the oscillograph mirror may be concentrated vertically, while at the same time they are free to move in a horizontal direction. The source of light is a vertical slit, whose image is thus concentrated to a point in front of the lens, *C* (or in this case on the screen above). In this way a brilliant image is obtained, while still using a very small mirror.

A valuable feature of the oscillograph as now constructed is that all the parts are mounted together in a compact case and there are no difficult adjustments to be made. The interior (Fig. 4) contains the oscillograph proper on the right with double mirror and on the left is the oscillating mirror with its motor and starting crank. A convenient form of synchronous motor has been devised which has no moving contacts. A horizontal fixed armature is wound with a six-pole winding and around it turns a horseshoe magnet upon a

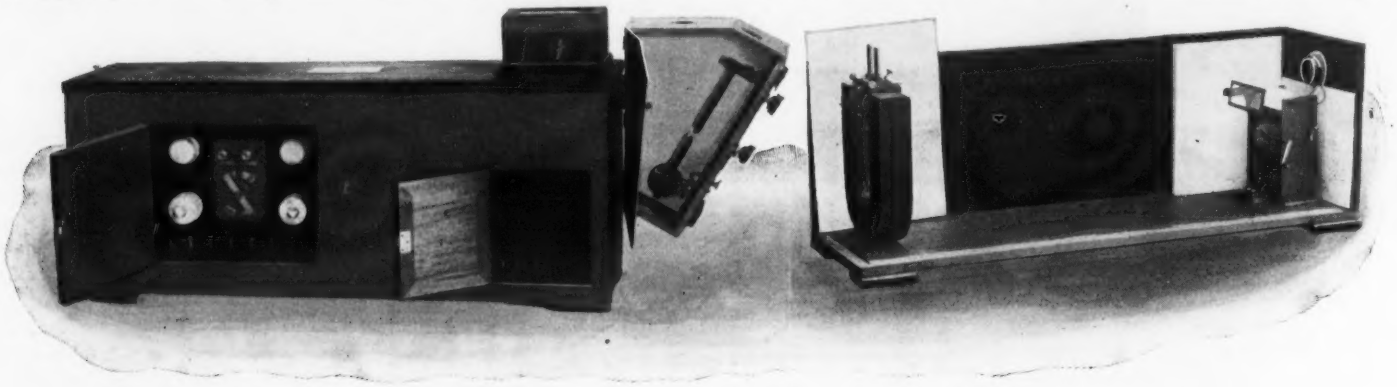


FIG. 4.—EXTERIOR AND INTERIOR VIEWS OF OSCILLOGRAPH.

pivot support with a shaft projecting at the top, which carries the cam. The exterior view of the box shows a hand-regulated arc lamp on the right, mounted in a sheet-iron box, which can be taken off. Above is a ground-glass screen upon which the wave is observed. To photograph the waves a plate holder can be inserted in place of the screen. The oscillograph can be used for lecture demonstration by taking off the screen and substituting a mirror inclined at

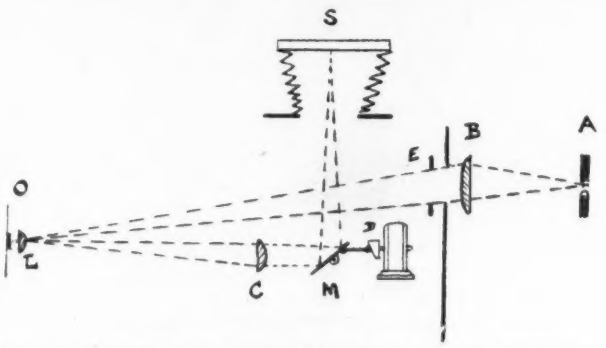


FIG. 3.—DIAGRAM SHOWING ARRANGEMENT OF APPARATUS.

45°, which sends the wave upon a screen a yard square placed at 3 or 4 yards distance. At the same time the cylindrical lens is replaced by a second of longer focus and the mirror tube is exchanged for another carrying a larger mirror of 0.04 in. diameter. This increases the brilliancy of the luminous point at the expense of the frequency, which falls to 4,000 or 5,000 per second, but the latter is sufficient for the purpose.

Resistance of Oil as Affected by Temperature and Impurities.

BY PROF. JOHN W. LANGLEY.

DURING the year 1902 a research on the electrical resistance of oils, as affected by temperature and impurities, was conducted in the electrical laboratory of Case School of Applied Science by two students, Messrs. C. E. Cochran and H. E. Fetzer. A steady pressure of 2,400 volts, derived from a storage battery, was applied through two copper electrodes in a metallic tank which could be heated.

The tank to hold the oil was made of a rectangular sheet of copper, so formed and folded at the corners that it was not necessary to make brazed joints. To the upper edge of two of the sides was fitted a small brass rod to facilitate handling. The tank was three inches by four and a half inches on the bottom, three and one-half inches by five inches on the top, and three inches deep. In order to protect the tank from sudden changes of temperature, it was enclosed in a sheet-iron oven lined with asbestos. The heat was applied by a Bunsen burner, which projected upward through the bottom of the oven.

The electrodes were made of sheet copper, two inches square and covered with mica on the back, but having the mica continued as a border on the front face around the edge, so as to reduce the area of the latter face to three square inches. This device prevented the current from passing by way of the edges, and compelled it to pass from the central portions of the electrodes in parallel lines through the oil.

The electrodes were suspended by small brass rods fastened to movable collars which were clamped to a glass insulating rod by means of thumb screws. The glass rod was supported by two small steel rods, one at each end, and secured by thumb screws.

1. LIGHT ENGINE OIL.	
30	1780
60	1243
90	506
120	209
150	78
180	60

2. CYLINDER OIL.	
30	803
60	65
90	30
120	8
150	5.2
180	5

3. COTTON SEED OIL.	
30	5110
60	1500
90	910
120	580
150	435
180	277
210	260

4. FISH OIL.	
30	1400
60	700
90	420
120	315
150	238
180	215
210	188

5. RAW LINSEED OIL.	
30	36.4
60	10.6
90	7
120	4.6
150	4
180	3.87
210	3.3

6. BOILED LINSEED OIL.	
30	5.9
60	4.44
90	3.1
120	2.32
150	2.1
180	1.75
210	1.3

7. LARD OIL WITH 1% BUTYRIC ACID.	
30	6120
60	2310
90	1000
120	610
150	302
180	59
210	54

8. ENGINE OIL WITH ¼% OF SOAP.	
30	5110
60	1000
90	220
120	70
150	40
180	16
210	9

9. PARAFFIN WAX.	
30	Infinite
60	4773
90	1000
120	575
150	310
180	217
210	158

10. LARD.	
30	6390
60	3100
90	1840
120	990
150	755
180	810
210	532

As the temperature of decomposition of oil is above the range of a mercurial thermometer, a pyrometer of the Siemens type was carefully calibrated and kept inserted in the oil during all the observations of resistance. A sensitive galvanometer was used to measure the current passing through the oil.

The oil being in the tank, the current and voltage at the electrodes are read, then the temperature is slowly raised about ten degrees Centigrade with constant stirring, and another reading of the galvanometer and voltmeter taken. These were continued by ten degree steps till the decomposition temperature of the oil was reached.

The current was very small, as was to be expected, ranging from .000001125 to .0003. The distance between the electrodes was constant at one-half an inch. In the tables given below the first column gives the temperature in Centigrade degrees and the second the resistance in megohms.

The effect of temperature in lowering resistance is apparent in all the experiments; also, that its influence becomes very marked above 90°, showing that incipient decomposition begins at this point. The action of impurities, such as acid and soap, is well shown by comparing tables 7 and 8 with 1 and 10 at temperatures of 60° and higher.

The resistance of linseed oil is exceptionally low, but the boiled oil is still lower, showing the effect of previous high temperature, and perhaps of the dissolved lead oxide which it contained. The low resistance of table 2, cylinder oil, would indicate that it had been adulterated with animal or vegetable oils, or, perhaps, soap to give it "body," which is known to be often done.

The high resistance of paraffin at low temperatures is in marked contrast with its failure as an insulator when heated above 120°. The resistances in the above tables are relative, not absolute, for they did not vary proportionally when the area or the distance between the electrodes was changed.

From the above, and numerous other measurements made on some twenty-five specimens of oil, pure and adulterated, the following conclusions seem warranted:

First. That at ordinary temperatures the resistance of oils is extremely high.

Second. That in order to have a high resistance the oil must be pure.

Third. That the resistance grows less with the per cent of impurity.

Fourth. That, within the limits of these experiments, the resistance is mainly of the nature of a contact resistance, and varies but slightly with change of distance between electrodes.

Fifth. That the resistance is not a direct function of the temperature, though it varies inversely with it in a general sense.

Sixth. That for temperatures above that at which marked decomposition of the oil sets in (150° C.) the resistance is practically constant, or approaches a constant.

Electric Canal Towage in Germany.

Mr. Frank H. Mason, United States Consul General at Berlin, Germany, writes to the State Department as follows about electrical canal work in the Empire: It is perhaps one of the compensations incident to Government ownership of railways, that it does not exclude or prevent due consideration of other methods of transportation. Notwithstanding the overshadowing interest of Prussia in her State railways, there is, especially in Imperial Government circles at Berlin, a keen and intelligent interest in all that relates to the improvement of internal water routes, for it is recognized that under existing conditions really cheap freights for raw materials and other coarse, heavy merchandise can only come from canal and river transportation. In deference to the general demand for improvement in this direction, the Government, early last year, formulated a plan for the employment of electric traction engines for towing boats on the Teltow Canal, a new work now in process of construction, which will connect the Havel with the River Spree just south of Berlin. The canal is to be 23 miles in length, with one lock, and passes for a short distance through a lake, where tugs instead of towing engines will have to be used. It is to be completed some time during next year, and is expected to have an annual traffic of about 1,500,000 tons. For obvious reasons, this new canal will offer an admirable opportunity for the employment of the most improved method of towing, and accordingly bids were solicited for an electric installation to comply with certain prescribed conditions, the motors being adapted to towing boats ranging from 175 to 600 tons loaded to 70 per cent of their capacity, and to be worked with a three-phase current of 8,000 volts and 50 periods. Twenty firms in all sent in tenders, of which the best known were Messrs. Siemens & Halske, Messrs. Ganz & Co., Messrs. Feldmann & Zehme, and the Société de Touage at Kiel. With characteristic forethought, the Government placed at the disposal of the competitors for preliminary experiments a sec-

tion of the Finow Canal, which connects the Havel and the Oder rivers at Oderberg, some distance north of Berlin, and there during the summer of 1902 a series of tests were made which attracted great attention from engineers and traction experts throughout Europe. The system of Messrs. Siemens & Halske appears to have been similar in general design to that of Mr. Richard Lamb, which was tested several years ago on the Delaware and Raritan Canal and later on the Erie Canal in the United States. The motor—which was little more than a working model—weighed 900 kilograms (1,890 pounds), and with a continuous current of 500 volts developed 5 hp. The stretch chosen for the tests included a curved channel, bridge crossings, and the usual difficulties that would be encountered in actual practice. It was found that in rounding a curve the light motor was derailed, and the experiment showed that for actual service the motor should be large and heavy enough to have at least 8 to 10 hp. To enable the towline to clear moored boats and other obstructions along the shore, the line was attached to the top of a mast 15 to 20 ft. high, and located centrally in the forward section of the boat.

Another example of the several proposed installations was the one submitted by Messrs. Ganz & Co., which is thus described: The locomotive is relatively light and has two pairs of wheels, which are set at a convergent angle, so that both pairs run on the same rail, the balance of the machine being maintained by a pair of trail wheels running along the adjacent roadway. Almost the entire weight, however, is borne by the inclined wheels on the single rail, and the arrangement is such that the heavier the resistance load created by the boat, the tighter the grip of the wheels upon the rail.

For an estimated annual traffic of 1,500,000 tons, it is proposed to equip one shore of the canal, and the service will require 53 locomotives capable of towing one boat of 600 tons or two of 200 tons each, besides six tugs to tow the boats across the lake. Whichever of the various competing systems may be adopted, it is certain that the Teltow Canal, when completed and equipped, will furnish a convenient object lesson of the latest and most improved application of electric traction to canal navigation.

Division of Labor in Mexico.

The principle of the division of labor may sometimes be misapplied. The London newspapers have lately been pointing out a wrong application in that city, where work on the streets has been divided up among as many trade unions as there are castes in India; with the result of exasperating slowness in getting the work finished. The picture shown herewith is a kindred illustration from Mexico, witnessed and captured by a well-known electrical engineer and reader of this journal. The process going on in the foreground is

MEXICAN LAMP TRIMMER AND TWO ASSISTANTS.

that of trimming an arc lamp, and it takes three persons to perform the operation. The lamp trimmer discharges his ordinary function, but here he requires two assistants. One of them carries and holds the ladder. The other totes the bag of carbons, pliers and other tools and passes them up to the chief electrician in proper order and with due ceremoniousness. The performance is here shown done to slow music, the onlookers in the background being engaged in endeavoring to determine the difference between a string orchestra and a rubber band.

Electrical Progress in Spain.

By Henry L. Geissel.

In Madrid last year, a prominent Spanish importer of American machinery remarked to the writer: "It is a blessing to our country that we have finally disposed of our colonies. For years, the best of our youth perished in the tropical climate of far-away possessions. The agricultural districts at home were suffering from the loss of our very best labor. Conscriptions took the boys away from our farms, and taxes upon taxes nearly destroyed our finances. We are now recovering. The Government is paying more attention to the development of our rich natural resources than ever before in the history of Spain, and municipal and private enterprises are making progress all over the country. Our finances are being strengthened, and confidence in our industrial undertakings is returning." I can but endorse every word of these remarks. I went through Spain in 1901, and again visited every province and all the industrial centers of the Iberian Peninsula last year.

Spain is making slow but steady progress in all her branches of industrial life. This is especially the case in electricity.

The improvements in electric tramways have given fresh impulse to the companies interested in them. During the last few years the increase in electric tramways in Spain has been very rapid, and the various lines already cover upwards of 200 miles. In the Province of Viscaya there were last year 68 miles of electric tramways, in Madrid, 26 miles; in Seville, 10 miles; in San Sebastian, the famous sea-resort on the Bay of Biscay, 12 miles; with lines in Barcelone and quite a number of other cities. Long lines were under construction from San Sebastian to Tolosa; from Cadiz to San Fernando; from Coruña to Burgo-Santiago, and from Arriandas to Covadonga. Further concessions for electric tramways were granted for the cities of Madrid, Valencia, Seville, Zaragoza, Coruña, San Sebastian, Barcelone, Cadiz, Oviedo, Almeria, Carthagena, etc. A number of these lines have already been completed and others are under way of construction.

The general use of electricity is causing the introduction of many valuable industries into practically deserted districts. Electricity generated by water power is beginning to play a very important part in the industrial development of Spain. Many of the smaller towns and country villages are lighted by electricity so obtained. In the district of Barcelone alone there are now more than 800 turbines in operation, representing 35,000 hp. Whenever water is found, factories spring up.

Until a few years ago the streets and houses of most of the small towns and villages which are now well lighted with electricity, were dependent on a few oil lamps and the lanterns of the night-watchmen. Once an electrical plant has been put in a village it becomes necessary to employ skilled labor. The residence of a few people of superior education in a village soon puts new life and energy into all its undertakings, and other improvements generally follow.

To what extent electricity has made strides ahead throughout Spain may best be seen by glancing at some figures. According to official returns there were in Spain, in 1901, altogether 639 cities and towns with electric central power stations. These plants were distributed among the 47 provinces on the mainland, and the two insular provinces—the Canaries and the Balearic Islands—as follows: The province leading in number of cities with electric central stations was Asturias, with 33, followed closely by Viscaya, with 31; Badajos, with 28, and Madrid with 26. Then came in order of importance, the provinces of Jaen, with 23; Seville, 21; Santander, 20; Cordoba, 20; Barcelone, 18; Navarra, 18; Valencia, 17; Guipuzcoa, 17; Ciudad Real, 17; Zaragoza, 16; Gerona, 16; Logroño, 16; Murcia, 15; Cadiz, 13; Malaga, 13; Alicante, 12; Albacele, 11; Leon, 11; Pontevedra, 11; Avila, 10; Coruna, 10; Castellon, 9; Lerida, 9; Granada, 9; Lugo, 9; Soria, 8; Salamanca, 8; Caceres, 8; Cuenca, 8; Huesca, 8; Tarragona, 7; Burgos, 7; Guadalajara, 6; Huelva, 6; Orense, 6; Palencia, 6; Valladolid, 6; Balearic Islands, 5; Toledo, 5; Segovia, 4; Almeria, 4; Alava, 3; Canary Islands, 3; Ternel, 3, and Zamora, 3.

Of cities and towns with a population of more than 4,000 souls, there were 430 in Spain last year where electricity had not as yet penetrated. In the provinces of Gerona, Huesca, Santander, Palencia, Zamora and Zaragoza there is but one town left in

each of them without electricity, while in Coruña there are 53; in Lugo, 43; in Pontevedra, 37; in Orense, 32; in Asturias, 19, and in Valencia, 19 without electric power stations.

The largest and most powerful plants are, of course, in the big cities. In many of them there are several power stations, as is the case in Madrid, Barcelone, Linares, Lugo, Malaga, Salamanca, Seville, Valencia, Bilbao, Zaragoza and others. The most prominent plant in Madrid is that of Compañia General Madrileña de Electricidad, equipped with ten steam engines of 6,600 hp total capacity, continuous current, of 115 volts. The price charged by this company is 11 centimos, or about 1¾ cents per kilowatt-hour for light and 5 centimos (0.8 cents) per kilowatt-hour for power. The plant of the Compañia Barcelonesa de Electricidad in Barcelone has 5 steam engines of 1,000 hp each, and the dynamos are from the General Electric Company of Berlin. The electric power station of San Sebastian was equipped by the Oerlikon Company (8 dynamos), that of Seville by the General Electric Company of Berlin, and one of the Malaga plants by Siemens & Halske.

The electric business in Spain is largely in the hands of German manufacturers ,and most of the installations have been built by the General Electric Company, of Berlin; Siemens & Halske, Berlin; Schuckert Company, of Nuremberg, and the Spanish branch of the Lahmeyer Company.

It cannot too much be regretted that our electrical manufacturers have neglected the Spanish market to such a large extent. In business and industrial circles in Spain, there is no feeling whatever against the United States, while there are splendid opportunities for the sale of our goods. Last year the imports of machinery into Spain exceeded in value $8,000,000, of which very little came from this country.

In many country villages the extremely moderate charge of two pesetas (about 30 cents at present rate of exchange) is made per month for one lamp of 10 candle-power per night, a fact which is largely responsible for the steadily increasing application of electricity. This small charge enables the poorest to have electric light in their houses.

Another consequence of the development of electricity is the formation of powerful companies in Spain. The German firm of J. Lahmeyer & Co., which has been established in the north of Spain for some years, has amalgamated with the Hispania Company, and bought the business of the Sociedad Bilbaina de Electricidad. The capital of the new company amounts to 30,000,000 pesetas ($4,500,000). Apart from its local business, it has secured important contracts, such as the lighting of the city of Carthagena and the supply of electrical power in the neighborhood of that town.

Several other companies were recently formed for the supply of current the two most important being the Sociedad Hidro-Electrica Iberica, which disposes of a capital of 20,000,000 pesetas ($3,000,000), and has secured water rights in various provinces throughout Spain. This company proposes to furnish power to Bilbao, Santander, Valencia and Alicante. It has begun work on the Ebro River, and expects to be in a position to supply 7,000 hp to Bilbao by the month of March of this year. The force is to be applied in various industries, such as corn and paper mills, tramways, tin plate works, etc. The other company is called the Sociedad del Salto del Ter, and has bought water rights for a sum of $150,000, with a view to furnish power to Gerona. The larger mining companies are also installing electric plants all over the country. The magnificent steel pier of the Rio Tinto Company, at Huelva, has been provided with an installation of arc lamps, whereby night work has been greatly facilitated, and their large depot within about a mile of the pier has also been lighted by electricity. A Belgian firm is now carrying on electric light plants in several mining centers of Southern Spain. The Coto Fortuna Mining Company, of Mazarron, has recently been equipped with a complete electric hoisting plant, which comprises the following international ensemble frequently found in Spain: Piedboeuf boilers, Schuckert dynamos coupled to 250-hp steam engines of the Swiderski system, and Sulzer high-pressure centrifugal steam pumps.

It will be seen from the above remarks that electricity is making progress in almost every corner of Spain. Let us hope that American manufacturers will try to secure at least a share of this trade.

Economical and Safe Limits in the Size of Central Stations.

AT the April meeting of the American Institute of Electrical Engineers, Mr. H. A. Lardner read a paper with the above title, in which he gave in connection with the discussion of the subject, much interesting data as to the relative economy of large generating units. In opening, Mr. Lardner said that if the territory is large and the system is to serve several villages or small cities with power for lighting or for railway purposes, one large station located conveniently for coal and water has a decided advantage, owing to economy in labor, lower cost of fuel, water and first cost.

Frequently the business in the individual towns would not be large enough to permit of an independent plant in each, and any risk of interruption to service is put up with because it is the best kind of service that such a community can support. In fact, until the class of territory approaches that of our largest cities, the question of lower first cost and economy of operation must in general rule; for the size of station is not large enough to minimize those advantages or to demand the advantages of a service supplied by several stations, harmoniously designed and operated.

When the territory becomes similar to New York, Chicago, Brooklyn, Boston, etc., the large station has many claims for consideration. As the central stations now built in this class of territory are so much larger than those which have been erected elsewhere, the discussion of the paper was confined to stations for the larger cities, and water power stations were excluded, as they must of necessity be located at the point of development or waterfall, and it is seldom the case that several plants can be built, each large enough to secure the maximum advantages of low cost and low operating expenses, as at Niagara.

The system of distribution which must be used, frequently has a direct bearing on the demand for a large station. Where the distribution pressure is low as in Edison three-wire, 120-240-volt systems, there are few if any cities where a sufficient load can be found for a very large station without exceeding the limited zone of economical distribution at this pressure.

Where this system is in operation we find that the stations are generally of high first cost and too small to be operated at the highest economy. The location is necessarily chosen without regard to the water or coal supply, and the load factor is generally very bad, which adds to the expense of operation. As a temporary expedient, at least, rotary converters, transformers and high-pressure cables have found a place for connecting together the direct-current stations and thus enabling them to exchange power and considerably improve their load factors.

For instance, in New York City the Duane Street Station of the New York Edison Company, with its heavy day load of motors and early evening load of office buildings, has a very different shaped load curve from the Twenty-sixth Street Station or the generating stations formerly located in Thirty-ninth Street and Fifty-third Street, which delivered their principal service during the evening. However, the double conversion results in losses which should be saved, and still continus the use of uneconomical small stations.

The next step is to establish a large well-located alternating-current station and feed the rotaries from the machines there installed. This method permits the use of the largest size of generating units, gives their attendant economies, and the demands of the various sections of a city coming at different hours of the day produces a better load factor.

The generating apparatus installed in the distributing or sub-stations, as they may now be called, can be operated if desirable, for one or two watches during the heaviest loads in their particular sections, and the combination undoubtedly results in greater economy. The existence of these sub-stations with generating apparatus, provides a certain amount of reserve or emergency power which can be called upon, and the danger of concentrating all the generating apparatus in one station is in a measure avoided. The fact of their existence also acts as an incentive to keep down the number of new generating stations and to build one alternating station large enough to meet the entire demands of the system, no matter how large that may be.

The use of the 240-volt incandescent lamp is much more common abroad than with us, and Mr. Lardner considers that a more insistent demand for a 240-volt lamp would be met by our manufacturers and

result advantageously. By the use of a three-wire system and 240-volt lamps, the advantages of 500-volt distribution in copper economy can be obtained, and the zones which can be served from any one station very considerably increased. It is an open question whether with this system of distribution the stations can be made large enough to be built for a fairly low first cost and operated at practically a minimum expense. There is a case in point in Boston, where the Boston Elevated Railway Company has a number of stations ranging from 1,500 to 4,000 kw, and the results of operation are reported to be very low and comparable to the best results which have been shown in much larger stations.

The alternating-current system of distribution with primary voltage of 2,200 volts and over, has the ability to serve a very extended territory. With this system of distribution, the question of one large station should not be so important, as the load can probably be divided between two or three stations, each large enough to be economical, and by the use of trunk cables they may aid one another in handling the load and add materially to the safety and continuity of the service.

Mr. Lardner gave the following table of authoritative tests on compound Corliss condensing engines. The best results published, and one near the average, are given for several different sizes:

Pressure.	Vac.	I.H.P.	Steam.
155	...	1950	12.5
150	26.9	1713	12.3
123	25.6	1592	13.5
133	25.2	1539	14.1
126	27.0	1107	14.1
120	...	1018	13.3
117	...	1001	16.3
151	...	997	12.8
112	...	709	15.1
144	25.2	741	13.2
159	25.4	595	12.7
90	...	548	13.5

It will thus be seen that under proper conditions of design and operation, very good comparative results can be secured with units much smaller than those installed in the large stations in New York. The published guarantees for the steam consumption are as follows, in these stations:

Station.	Pressure.	Vac.	I.H.P.	Steam.
The New York Edison	175	27	5500	12.5
Manhattan Railway	150	26	8000	13.0
Metropolitan Street Railway	160	..	4500	13.14

That part of the cost of labor for engine operation, which varies with the size, amounts to but a small portion of the total operating expenses; and although the larger the unit, the smaller the item becomes per horse-power-hour, it is relatively of little importance, except in very small units.

The question of floor space required for reciprocating engines of different sizes, demands the largest units practicable. The vertical space required by an engine is provided more cheaply than the floor space, and as the requirements are of three dimensions, the floor area should not increase proportionally with the size of the unit. Again, the aisle space must be practically the same for engines differing in size by large percentages.

In spite of these facts, the floor space in engine rooms per horse-power appears to be affected more by the type of engine used and the judgment of the designer than by the size of the unit. The Edison station with engines of 5,500 hp normal rating require only about one-third of a square foot per horse-power and the Metropolitan, with 4,500 hp-units, one-half of a square foot per horse-power, against the 8,000 hp-units in the Manhattan station, with an area of .55 of a square foot per horse-power.

It therefore appears that economy of operation and in floor space may be made entirely too much of in discussing the advantages of large units, although with similar design and type of machinery, the large units undoubtedly have some advantages, provided the station is large enough to require a sufficient number of units to permit of economical loading.

The following table gives some published data about the engines in the New York Edison, Manhattan Railway and Metropolitan stations:

Engines.	Metropolitan.	Manhattan.	Edison.
Number	11	8	8 installed 16 ultimate
H.P. each normal rating	4,500	8,000	5,500
H.P. each maximum rating	6,600	12,500	8,000
Aggregate rated H.P.	49,500	64,000	88,000
Aggregate maximum H.P.	72,600	100,000	128,000

From the large number of units, we may assume that these are the largest machines the manufacturers cared to produce. Larger engines have been built for use aboard ocean liners, and as conditions are in many ways much more severe aboard ship than on land, it should be possible to have still larger units if central station engineers really demanded them. The following data apply to the engines of the *Kaiser Wilhelm der Grosse:*

Two engines, triple-expansion, four cylinders; diameters, 52, 89.7, 96.4, 96.4 in.; stroke, 68.8 in.; piston speed, 885 ft. per minute; revolutions, 77 +; steam pressure, 178 lb.; rated horse-power of each engine, 15,000.

The steam turbine presents some characteristics which will affect decisions in regard to the arrangement and number of stations for a given system, and although much has been written of them lately, they may be briefly alluded to here. This type of prime mover has decided advantages over reciprocating engines for driving many classes of electrical machines, as it gives ideal conditions for the parallel operation of alternators and synchronous apparatus on account of its uniformity of angular velocity. We are assured that steam turbines run together in parallel with the same facility as hydraulic turbines have always done. It is well known that many difficulties in the operation of 60-cycle apparatus disappear when the supply of power is from water wheels, and if the steam turbines are to help us in this respect it will be a great point in their favor.

There is every reason to believe that the use of superheated steam with turbines will be a comparatively simple matter, as the turbines will have no internal rubbing surfaces or cylinder oil. Exhaust steam from turbines being free from oil, may be condensed and returned to the boilers, and this will be an important consideration in many plants now purchasing city water for boiler feed and which find the extraction of oil too difficult and expensive to permit the water being used a second time. Owing to the high speed at which turbines are operated, direct-current machines seem to be ruled out on account of commutator troubles.

Perhaps the greatest advantages of the turbine is its economy of floor space. The statement has been made that the Westinghouse-Parsons turbine requires about 80 per cent. of the space needed for the vertical and not over 40 per cent. of that wanted for the horizontal engine. This statement is based on a station layout with a clear space of seven feet in all directions between machines. This type of turbine being horizontal, requires less head room and consequently a cheaper building by a considerable amount than the vertical engine. Curves given place the required building capacity for turbines at about 50 per cent. of that for vertical engines.

The Curtis turbine of the General Electric Company is of the vertical shaft type, and while it requires more head room than the Westinghouse-Parsons machine, is very economical of floor space. The following table gives the principal dimensions of some of the sizes which are now being built.

CURTIS TURBINES AND GENERATORS.

Size.	Height.	Diameter.	Floor space.	R.P.M.
500 k.w.	12' 2"	7' 8"	46.2 sq. ft.	1800
1500 k.w.	16' 10"	10'	78.5 sq. ft.	900
3000 k.w.	22'	14'	154. sq. ft.	600
5000 k.w.	27'	14' 10"	175. sq. ft.	500

WESTINGHOUSE-PARSONS TURBINES AND GENERATORS.

Size.	Height.	Dimensions.	Floor space.
400 k.w.	7' 6"	19'x5'	95 sq. ft.
1000 k.w.	8'	43'x8'	344 sq. ft.
5500 k.w.	15'	50'x12'	600 sq. ft.

For comparison, the following is the floor space required by the vertical cross-compound condensing engines of a well-known maker. The figures include the space required for an alternating-current generator between the frames:

Size.	Dimensions.	Floor space.	R.P.M.
500 k.w.	15'x22'	330 sq. ft.	120
1000 k.w.	21'x24'	504 sq. ft.	110
1500 k.w.	22'x28'	616 sq. ft.	100
2500 k.w.	23'x32'	736 sq. ft.	90
3000 k.w.	23'x34'	782 sq. ft.	75

The height in all sizes thus exceeds that of a similar size of vertical turbine.

The steam consumption guaranteed for the above-mentioned Curtis turbines are attractive, especially at light loads. The figures are given in dry steam per kw-hour and for purposes of comparison with results per indicated horse-power, they have been reduced by

assuming an efficiency for generator and turbine of 85 per cent.:

Size.	Pressure.	Vacuum.	Lbs. steam per k.w. hour. Full load.	Half load.	Lbs. steam per i h.p. Full load.
500	150	28	20½	23	13
1500	150	28	20½	22	13
3000	150	28	20½	21.5	13
5000	150	28	20½	21	13

The simplicity of the turbine leads us to believe that the high efficiency will not decrease with use nor by reason of lack of adjustment. The method of guaranteeing the efficiency of generators and engines together, will permit this guarantee to be checked more closely than has ever been possible with large engines and generators, on which separate guarantees have been given.

The cost of labor for engine operation will be considerably cheapened with the turbine, and this and the other advantages shown should greatly reduce the necessity for very large units. If, therefore, steam turbines are to make the operation of smaller stations (with a suitable number of units to handle the load economically), equal in efficiency to some of the largest plants now installed, it will be advantageous in many cases to install several stations in place of one, and secure all the saving in distribution and safety against shut-downs that go with such an arrangement.

There are, of course, certain cases where a location cannot be secured convenient to coal and water in more than one place, but these cases are rare. Boston, New York, Chicago and nearly all our largest cities afford opportunities for securing a number of sites, all practically of equal desirability so far as facilities for getting supplies are concerned.

The advantages of large central stations may be summed up from what has been previously said, and consist mainly of the following:

The location of the station on the one most suitable site for the coal and water supply. The reduction of floor space by the use of large units. The economy of fuel secured by the use of large generators and engines. The economy of labor and general superintendence secured by the use of large units in one building. The saving in first cost effected by the installation of a large station with large units. The economy of operation secured by serving many sections of a city with different hours of maximum demand from one station, due to the better load factor obtained.

The installation of a large station presupposes supplying a very large territory from one source, and in order that the coal and water supply may be convenient, the chosen location is generally much further from the load than when it is divided among several plants. This involves a greater expense for a distribution system, although this may be minimized by the installation of high-potential current or by local conditions.

The economy of floor space by the use of large units will always be an important consideration where land is valuable, but the economy in this direction with the steam turbine may lead the designer of the future to give less consideration to this point.

The added economy of fuel, labor and general supervision in large units will also be reduced somewhat even with the large turbine units, and the first cost of the machines themselves will undoubtedly decrease per unit capacity with increase in size. However, the reduction in cost of turbine generator installation, from the prices now paid for generators and slow-speed reciprocating engines should be considerable and permit smaller units than are now feasible. This will undoubtedly be true after development charges have been cared for.

It is a question whether there is any saving in the first cost in the installation of very large stations, except in prime-movers and generators. The construction of double and triple-decked boiler rooms, long coal-handling apparatus and coal pockets high above the ground, involves heavy expenditures without compensating advantages. It is probable in the case of some large stations in this city that they could have been built to half their capacity as cheaply per unit as to the ultimate size. The size of the units in either case would probably have been the same.

The principal disadvantage of the very large station is the danger to a system if the disabling of the station leaves the company without a source of power, or takes away a larger portion of its supply than can be cared for by overloading the remaining plants. It is with this point in view that I have attempted to bring out all the points which may make smaller stations worthy of more consideration than they frequently get.

The stations in this city are wonderful examples of good design in all features which tend to make them reliable and free from dangers of serious break-down and interruption of service. As one designer said in describing his station, it was built to withstand anything but an earthquake or a bombardment. While it may be possible to build such a station, I do not believe that there has been a single station built, and I do not look to see one, which is free from weak points capable of causing interruptions. These features are apparently unavoidable, and while accidents due to them may not do any serious or expensive damage, they may render the building untenantable to employees or to enough of them to cause an interruption to the service.

The recent break-down at the station of the Niagara Falls Power Company is an instance in point, and while such occurrences have been rare, the one in question left Buffalo without Niagara power for twenty-four hours, and the Niagara Falls district was without power for nearly two days. I do not think an officer of a large company will look on a like condition without considerable apprehension. The trouble at Niagara is reported to have been started by a lightning storm, which resulted in destroying the cables leading across the bridge from the generator room to the transformer house. Now that it is over, engineers say that there should have been two routes for these important cables, and a number of suggestions may be made to avoid a repetition of the difficulty.

Shut-downs have occurred in some other large stations during the experimental periods of their operation, and while these were doubtless due to poor material or workmanship that had not been weeded out, the failure of material or errors of employees may occur after years of use, and the results are likely to be the same.

Instances occur in this city where cables may be damaged by one cause or another, and the results would not be very different from the Niagara break-down. Rheostats for the fields of generators may be the weak point in another station; switchboards exposed to flying pieces in another. These weak points can generally be corrected, but the fact is that they now exist and are in my opinion possible sources of trouble.

In conclusion, Mr. Lardner said that he does not advocte a greater refinement than is commercially justifiable, and perhaps this point has been reached by the designers of the large stations; and that smaller stations need not lack many of the advantages of the large ones, and with a number of them in place of one large plant, the necessity for excessive refinement ceases to exist.

Death of Professor J. Willard Gibbs.

Prof. J. Willard Gibbs died suddenly at his residence in New Haven on April 28. He had been sick for several days, but his illness was not supposed to be of a serious nature. His death was due to heart trouble.

Josiah Willard Gibbs, Ph.D., LL.D., Math.D., Professor of Mathematical Physics at Yale, whose father, of the same name, was a famous philologist and Biblical scholar, was born in New Haven, Conn., on February 11, 1839. After graduating from Yale in 1858, he pursued special studies in mathematics, and took the degree of Doctor of Philosophy in 1863, subsequently spending three years as a tutor in the college, and then going to the universities of Paris, Heidelberg and Berlin. In 1871 he became Professor of Mathematical Physics in Yale, a position he continued to hold. Along with his regular duties he did a great deal of lecturing at various other institutions. His work was principally in the development of graphical and analytical methods in thermodynamics, and for his researches the American Academy of Arts and Sciences gave him its Rumford medal.

In 1879 he was elected a member of the academy, and he was vice-president of the American Association for the Advancement of Science in 1886. His publications include many standard works on his chosen subject, and in late years he had been especially noted for his system of vector notation, simpler than that of the quaternians and more approximating to the German notation. Williams College and Princeton both honored him with the degree of Doctor of Laws, the latter in 1896.

The most noted work of Prof. Gibbs was in the application of thermodynamics to considerations of chemical equilibrium, the value of which is receiving greater and greater recognition with the development of modern theories of chemistry and particularly of electrochemistry and physical chemistry. His work in this field is indeed ranked as among the most important combinations in the last century to mathematical chemistry and physics.

April Meeting of the American Institute of Electrical Engineers.

At the April meeting of the American Institute of Electrical Engineers held last Friday, three papers were read relating to the central station, the authors being Messrs. H. A. Lardner, Peter Junkersfeld and Philip Torchio. The discussion which followed the reading of these papers is given below, together with abstracts of the papers of Messrs. Torchio and Junkersfeld, which will be printed in full next week; the paper by Mr. Lardner is printed elsewhere in this issue.

At the meeting Mr. Pope announced that at the afternoon meeting of the Board of Directors no less than 211 associates were elected. The board transferred to full membership Messrs. S. E. Johansenn, M. Von Recklinghausen, Robert Robinson and William Estey. The secretary also announced that the Board of Directors had received a communication from Mr. C. O. Mailloux, enclosing his check for $1,350 as a further contribution to the library of the Institute, $1,000 of this sum being specified as a fund to be set aside and the interest expended to keep up the sets of *Transactions* which Mr. Mailloux has donated to the library; the remainder to be used in purchasing other sets, for binding, etc.

Following the secretary's announcements, President Scott stated that a guest from Europe, Dr. Adolph Franke, technical director of the Siemens & Halske Company, was present at the meeting. He added that Mr. Franke had just put in service the longest Pupin telephone circuit yet installed, 450 miles in length, from Frankfort to Berlin. Only about one-quarter of the usual amount of copper was required and the telephonic results are excellent. Dr. Franke begged to be excused from making any remarks owing to the imperfection of his English.

In introducing the paper of the evening, Mr. Scott called attention to the fact that the use of tools and machinery, together with the generation and the application of mechanical power, have brought about a new order of things in the relations between individuals and the relations between nations; manufacture and commerce have passed through a wonderful revolution; commercial conditions have changed. Society, he said, is not merely an aggregation of individuals, nor simply a mass of men, but a vast unit. Men are not independent; they are co-related and interdependent. No extension is so completely representative of modern development as is the central station. In it is found the application of nature's forces on a most comprehensive and diversified scale, and it is typically representative of co-operation and combination in design and construction; in the combustion of coal and the production of steam, the operation of engines and condensers, of dynamos and switches, of indicating instruments and safety devices, of conductors and cables, and the operation of apparatus in sub-stations and on the premises of a thousand customers. Referring to the reliability of the modern central station, he said that the Edison system now in New York City, as a whole, has never been without current, and added that on March 31, 1903, the New York Edison Company of Manhattan Island were supplying current to 26,000 customers, a total equivalent in 16-cp lamps of 2,391,431.

After Mr. Scott's address the papers of the evening were read, the first on the programme being that of Mr. Lardner, entitled, "The Economical and Safe Limits in the Size of Central Stations," which is reprinted elsewhere in this issue. The next paper was read by Mr. Philip Torchio, entitled, "Safety Devices in Central Stations and Sub-Stations." The paper relates more particularly to high-tension systems. After some general considerations a tabulation is given under 33 heads of desirable safeguards, classified under the general heads of generating stations, transmission lines and sub-stations. A reprint of this portion of Mr. Torchio's paper will be given in the following issue. The third paper of the evening was by Mr. Peter Junkersfeld, engineer of the Chicago Edison Company, and entitled, "Multiple vs. Independent Operation of Units and Central Stations." Troubles affecting the service of central stations are considered in detail under the heads of mains and services, low-tension feeders, sub-station apparatus, high-tension transmission lines, generators, prime-movers and auxiliaries, and steam supply. These are considered in detail with particular reference to the Chicago system. In conclusion, Mr. Junkersfeld advanced considerations favoring the independent operation of generating units, either in one generating station or in several stations. A reprint of Mr. Junkersfeld's paper will appear in the following issue.

The discussion on the several papers of the evening was excellent, perhaps the best that has taken place for some months. Owing to limitations of space a brief outline of it will here be given, and the greater part will be printed in full in the following issue.

President Stott, in opening the discussion, called attention to the fact that the burden of the papers is notable for the reason that they do not set forth the general theory of the inter-relation of parts, the characteristic of engines or dynamos, of efficiency of regulation, but refer to those elements which come up in connection with a design beforehand. They deal more particularly with emergency conditions. Mr. H. G. Stott, after sketching the development of the central station, took up the question of steam generators. Referring to the steam turbine, tests of its performances, he said, seemed to indicate that it did not equal the best reciprocating engine in efficiency. As to floor space, too much stress had been laid upon that point for the reason that the limiting feature in all large stations is the boiler unit; and to get the best distribution of steam the turbine units would have to be spaced approximately the same as steam engines, so that economy in floor space is not a very important point. He said that high-tension underground cables are a great deal safer than low-tension cables. The storage battery he considered merely as an assurance against shut-down and not as a means of economical operation. He strongly opposed the independent operation of units.

Mr. Herbert Wagner expressed an opinion in favor of the use of motor-generators instead of rotary converter, the motors being of the induction type. He said that a cross-compound engine using superheated steam can be made equally as economical as a triple-expansion engine, and that single-cylinder engines using high superheated steam have almost equalled in economy triple-expansion engines. Mr. E. H. Sniffen said that experience thus far had with the Westinghouse-Parsons steam turbine shows it has a higher commercial efficiency than the reciprocating engine. At Hartford, Conn., 1,900 kw is developed with the steam turbine with the same fuel consumption as was previously required to develop 900 kw with two Corliss engines.

Mr. John W. Lieb, Jr., declared himself in favor of a single generating plant instead of a multiplicity of such plants, and stated that the experience of all large central stations operating transmission systems to sub-station, has shown that the storage battery is as absolute a necessity as an auxiliary as either the rotary converter, motor-generator or other equally essential pieces of apparatus. Mr. Townsend Wolcott said that there would not be the same advantage in the use of superheated steam in turbines as in reciprocating engines. In the latter the superheat prevents condensation, whereas in the turbine when the steam expands it does so without doing any work. Mr. W. S. Rugg expressed surprise that no attempt has yet been made to actually lay out an Edison multiple-unit station. Such a station he thinks would combine nearly all the advantages which have been brought out in the papers, since it could be designed so that the total operating expenses would be but little more than those in one room or two rooms, and at the same time there would be the advantage of a number of stations. Mr. A. V. Abbott considered that in discussing the subject of the evening the manager's standpoint should not be neglected, and the question of subdivision of a station into a number of units might well be considered from an insurance standpoint. On the one hand, there is perhaps greater cost of operation, but on the other, greater security. Mr. Junkersfeld, in referring to a remark of Mr. Lieb concerning the difficulty of getting suitable real estate for central stations, said that this difficulty had been encountered in Chicago and consequently a great multiplicity of plants is impracticable there. He said that Mr. Stott's remarks about high-tension cables giving less trouble than low-tension cables coincided with experience in the Chicago plant. As to storage batteries, with a peak of one hour the battery will pay, whereas if the peak is more than an hour and a quarter it will not pay. Mr. Lardner said that in New York he would advocate subdividing a central station system into two or three plants instead of one; and as to the difficulty in securing sites in New York City, he directed attention to the waterside plants at Kingsbridge, Ninety-fourth Street, Seventy-fourth Street, Fifty-ninth Street and Thirty-eighth Street. Mr. Torchio advocated the use of the storage battery as an auxiliary and referred to a plant operating at Milan, Italy, where the use of a battery for but a few days in the year enables the company to sell annually an additional three or four thousand kilowatts at $60 per horse-power-year.

The New Home of the New York Stock Excnange.

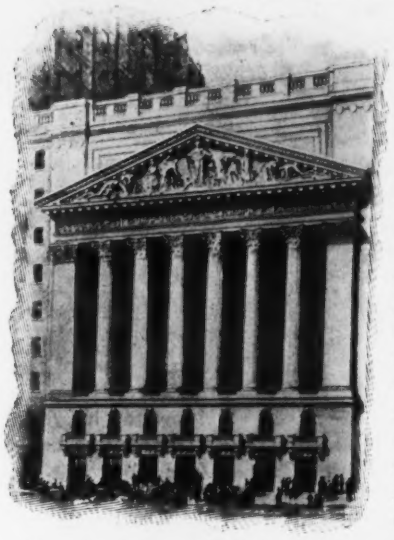


FIG. 1.—NEW YORK STOCK EXCHANGE.

A function that was largely attended last week by people of prominence in the electrical world was the opening of the magnificent new home of the New York Stock Exchange, whose total cost, inclusive of real estate, is understood to reach about $6,000,000, or about £1,250,000 sterling. The structure has a frontage of 137 ft. on Broad Street, 152 ft. on New Street and 14½ ft. on Wall Street. Its facade rises 156 ft. above the pavement on Broad, and the total contents are 4,300,710 cu. ft. The building not only contains the superb board room, but safe deposit vaults, luncheon club rooms and other features conducive to the comfort and convenience of the brokers who will do their work within its walls. We present herewith a good view of the beautiful board room, lined with colored marble, rising 74½ ft. in the clear, and being 144 ft. wide by 109 ft. long.

The electrical equipment has received unusual attention and the best experts obtainable were employed to design and carry out the plans. The equipment consists of a lighting and power plant located in the engine room three stories below the sidewalk level. Two 250-kw and one 150-kw generators operated at 235 volts, of the General Electric type, each direct-connected to a Ball & Wood center-crank tandem-compound, non-condensing engine, furnish the current for illumination, elevators and various motors, also serving to charge the storage battery used for lighting and the smaller batteries and motor-generators furnishing current for bells, telephones, signals, etc.

The main lighting and power switchboard of Italian marble, with its bronze pedestals and highly polished apparatus is a work of art, eqnalled only by the two smaller boards, one used for the control of the storage battery system and the other for the bell and telephone apparatus. Instructions were given to spare no expense in producing the finest and most serviceable piece of work.

The wiring system is of the most recent type. Every piece of wire in the building was installed after the plastering, marble and woodwork were in position and it is claimed that the wire could all be removed and replaced without a particle of damage to the building and without requiring the cutting or splicing of a single strand. The materials employed are those well known to the electrical fraternity. The conduits are Electroduct steel type, the wires and cables being manufactured by the Safety Insulated Wire & Cable Company.

The building is illuminated with 6,000 16-cp, 235-volt incandescent lamps and 75 arc lamps of the enclosed type. Twenty-five motors ranging in horse-power from ½ to 40, are located throughout for operating ventilating, pneumatic, filtering and dumb waiter apparatus.

The large board room is lighted with 75 arc lamps arranged with special reflectors so constructed as to form a part of the ceiling decoration. This brilliant lighting is reinforced with a background of thousands of dollars' worth of gold leaf.

Telephones are provided in the principal rooms and ticker and telegraph apparatus are found at every turn. An interesting portion of the equipment are the two large annunciators on each side of the board room with a total of 2,400 calls for calling members on the floor. Each annunciator board is approximately 50 ft. in height by 36 ft. wide and the mass of conduits and cables connecting these two pieces of apparatus alone is extraordinary.

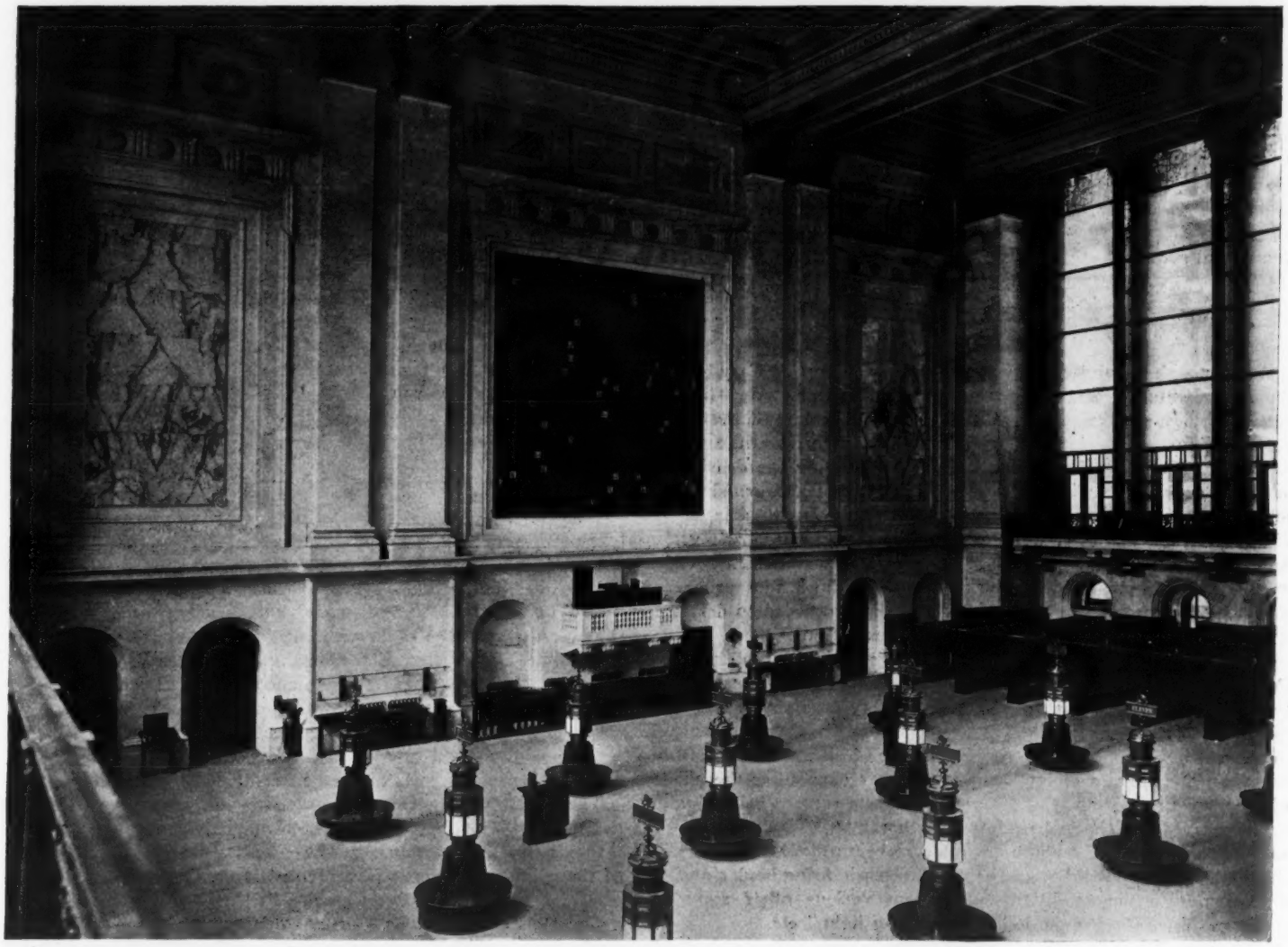


FIG. 2.—GENERAL VIEW OF TRADING ROOM, NEW YORK STOCK EXCHANGE.

A messenger call, elevator signal, fire alarm and watchman's time detector system, all of the most recent type and of most elaborate design, are also provided.

Some of the interesting data furnished from the records of the Charles L. Eidlitz Company, New York City, who installed the equipment, are as follows: Total horse-power in engines for operating the plant, 1,040; total kilowatt of generators, 650; number of incandescent lamps, 6,000; number of arc lamps, 75; number of motors of various sizes, 25; total weight of steel conduit for lighting, power, telephones, bells, signals, etc., 1,144 tons; total weight of copper wire, 16 tons; total length of electric lighting, bell, telephone and annunciator cables in actual lineal feet of various sizes, 1,543,200 ft. The Chloride storage battery of 135 cells has a capacity of 400 lights for eight hours.

With respect to the telephone service of the exchange it may be added that the equipment of Bell apparatus furnished through the New York Telephone Company includes 502 private line stations, arranged in the booths and alleys seen at the side of the exchange floor for the exchange service of members. There are also nine public telephones in the New Street lobby, four in the Commercial Cable Building annex room and two in the Broad Street ground floor smoking room. There is also a special private board exchange for the use of the executive offices, including a switchboard, three trunk lines and eight stations.

Other facilities for communication embrace the pneumatic tube system. From the board room, tubes run to all portions of the building, offices, cable and telegraph companies, and are so arranged that messages sent on the longest tubes arrive at their destination to the fraction of a second, that a message on the shortest line requires. There are about 6 miles of brass and iron tubing and 175 automatic terminals. Included in the elevator outfit are five electric dumb waiters.

It may be added that the demolition of the old Stock Exchange Building on the same site began April 27, 1901, so that the whole work has been completed in just under two years. The governing committee of the Exchange have shown their appreciation of the work of the Building Committee by erecting a bronze tablet on the interior wall of the Exchange with the names of the committee, as follows: R. H. Thomas, chairman; J. T. Atterbury, Ernest Groesbeck, R. P. Doremus, H. G. S. Noble, Rudolph Keppler. To these gentlemen also gold medals have been presented as souvenirs of their labors and success.

Smoke and the Determination of its Density.

A paper with the above title was read by Mr. Albert A. Cary before the annual meeting last week of the New England Cotton Manufacturers' Association. After giving a concise account of the manner in which smoke is formed and of its composition, the paper took up methods that have been used in determining the density of smoke as it issues from the chimney. This is best accomplished by the use of a smoke chart consisting of five rectangles printed in different shades, namely, light gray, darker gray, very dark gray, light black and dense black. Owing to the care with which such a chart has to be printed in order to bring out the shades properly, it cannot be reproduced here. Mr. Cary then proceeded to describe a method of recording smoke density determinations.

When making smoke density determinations it is desirable to note the condition of the smoke at frequent and equal intervals of time. Every half minute has been found a very satisfactory interval. When the test is an important one, not less than two separated observers should make records with the time of observation carefully noted on their sheets along with the number expressing the shade of the smoke existing at that time; the separate records being finally compared and one checked against the other.

At the same time the above records are being made, some one in the boiler room should note the time of each firing and cleaning and also state the conditions existing at various other recorded times, such as "forcing the boiler," "running light," etc.

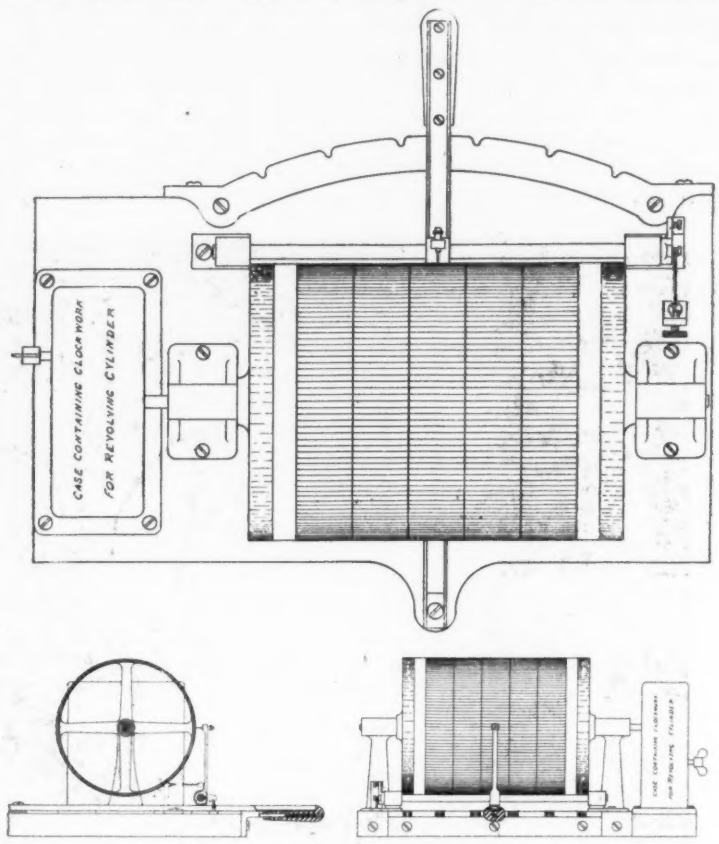
If furnace gas analyses are made during the time of these observations, and if the result of these analyses along with all of the other observed results are finally plotted on cross-section paper, we will be able to make a careful analysis of existing conditions pertaining to the production of smoke in the plant under consideration, and means for further suppressing the smoke can generally be found by making proper deductions from such plotted diagrams.

A time keeping apparatus was used by the smoke observers during the Paris smoke tests (conducted in France between 1894 and 1897). This device contained a cylinder driven by clockwork, and around this cylinder is placed a paper on which the record is written (similar in manner to the paper placed on the drum of a steam engine indicator). The drum of the smoke-recording device is turned the same as the hands of a clock; a given distance around the circumference representing accurately one minute.

The pencil, pressing against this paper on the drum, is moved across the face of the cylinder (parallel to its axis) by the observer, who pulls the slide rod carrying the pencil, to its extreme left position when there is "no smoke." This causes the pencil to draw a line around the circumference as the clockwork revolves the cylinder, which line marks a zero position. When "slight smoke" was seen, the observer moved his slide rod one division to the right, which caused the pencil to mark a line around the circumference of the revolving cylinder a definite distance to the right of the zero line.

The slide rod was again moved another division to the right when "medium smoke" appeared, which caused the pencil to trace a new line, double the distance of the last one (for slight smoke) from the zero line.

As "black smoke" appeared, the pencil was again advanced to



SMOKE DENSITY RECORDING DEVICE.

the right another equal distance, and, finally, when "very thick smoke" appeared, the observer pushed the pencil as far to the right as possible, and so the five equidistant circumferential lines represent the five different degrees of smoke adopted by the Paris Smoke Test Commission, and with the recording cylinder constantly revolving, we find our smoke record finally plotted on the paper, the same as if we had plotted it on cross-section paper calling the ordinates, time, and the abscissa, degrees of smoke density.

The accompanying illustrations show an apparatus of this kind devised by Mr. Cary, which is an improvement upon the Paris machine. It will be seen that the pencil is moved along the length of the cylinder by means of a pivoted lever, the outer end of which is grasped by the operator's hand. As the lever is moved, a spring detent slips easily into (or out of) one notch after the other in the segment on which the outer end of the handle rides, each notch holding the pencil in position on the paper corresponding to the degree of smoke observed.

Since producing this time-keeping apparatus, Mr. Cary had devised a further improvement on this machine, which allows the use of a long roll of ruled cross-section paper and also reduces the size of the smoke recorder.

Recent Electrochemical Developments.

BY CLINTON PAUL TOWNSEND.

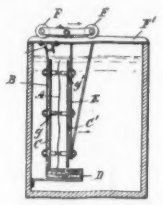
RECOVERY OF COPPER AND NICKEL FROM ORES.

Following are given the details of a method patented by E. A. Sjöstedt and J. H. James, of Sault Ste. Marie, Canada, and assigned to Francis H. Clergue, for the separate recovery of copper and nickel from mattes and ores. The novelty of the method does not lie in the application of any new principle, for the process consists, in outline, in dissolving the metals by sulphuric acid, electrodepositing the copper from the resulting acid solution with insoluble anodes, then making the solution ammoniacal, separating the iron by an air-blast, and finally depositing metallic nickel from the heated bath. In adopting this general procedure the inventors merely follow many earlier investigators, but their manipulations are given in detail and are of interest.

The bessemerized matte or roasted ore is treated for 8 to 10 hours with 40 per cent. sulphuric acid at the boiling point, and the resulting solution, containing the sulphates of nickel, copper and iron, is diluted to a sufficient extent to retain the salts in solution after cooling, the acidity being thereby reduced below 3 per cent. Copper is now deposited, using copper cathodes and insoluble anodes (graphite or platinum) and a current of .3 amp. per square decimeter, the electrolyte being agitated meantime by a current of air. The separation of the copper is continued so long as the deposit is of good physical character, and the solution, the acidity of which has been increased in proportion to the quantity of metal separated, is then returned to the ore; after being thus strengthened the deposition of the copper is continued, this alternate deposition and solution being repeated until the liquid is sufficiently concentrated in nickel. Thereupon the copper is completely separated, the last traces being removed if necessary by filtering through a bed of sulphide of iron or nickel; the solution is nearly neutralized by caustic soda, then rendered ammoniacal, and the iron precipitated by a blast of air. The nickel is now deposited from the resulting neutral or slightly ammoniacal solution with insoluble anodes and nickel cathodes, the solution being agitated and heated by a blast of hot air. During the deposition of the nickel a current density of .6 to .9 amp. per square decimeter is maintained.

ELECTROLYTIC GALVANIZING.

Heinrich W. Bötz, of Ludwigshafen-on-the-Rhine, Germany, patents a novel and convenient device for handling large and flexible metal sheets in the plating bath. The apparatus is designed particularly for electrolytic galvanizing, and is intended to permit the zinc anodes to be brought into close proximity to the sheet metal (iron) to be coated, while securing a positive spacing by means of pointed distance pieces. One form of the device, shown in the accompanying sketch, comprises a vat, having therein two anode holders, *B* and *E*,



ELECTROLYTIC GALVANIZING.

the former being stationary and fitted with a foot piece, *D*, for supporting the metal sheet to be coated, and the latter mounted for horizontal movement upon a carriage, *F*, moving upon rails, *F'*, upon the vat. The zinc anodes, *C*, *C'*, are perforated, and through these openings project inwardly from each anode holder the pointed distance-pieces, *g*, *g'*, of glass or porcelain. When the movable anode holder is brought into the relation to the stationary holder indicated in the figure, the distance-pieces serve to support the flexible metal sheet, *A*, from opposite sides, the distribution of the distance-pieces over the surface being such as to prevent any serious buckling of the sheet, and to avoid danger of short-circuiting from this cause. If desired, the position of the sheet may be shifted slightly from time to time during the electrode deposition of the zinc, but this is not important, since the zinc deposit is capable of protecting the iron for a distance of several millimeters beyond its own limits. The pits due to the distance-pieces do not, therefore, seriously injure the sheet, and the iron is stated to show no tendency to rust in these minute uncovered areas.

New Telephone Patents.

In the days of flat-rate telephone service, when the number of messages and the cost of service bore no tangible relation, it was common practice for many telephone subscribers to offer openly the use of their telephones to neighbors and friends or customers, as the case might be. Unfortunately, the habit of borrowing telephone service thus formed has outlived the conditions under which it originated, and in some instances where the message rate system has been exclusively adopted, it has proved a considerable nuisance to a certain class of stores. The automatic pay station has, of course, furnished one method of overcoming this difficulty; but it requires the subscriber to have a special contract and to deposit personally a coin each time he calls. A second kind of device for stopping the promiscuous use of a subscriber's telephone by outsiders is the subject of a patent of the issue of April 14, granted to J. E. Head and assigned by him to The Controller Company of America, of St. Louis.

This device is a special form of the hook switch lock and is shown in Fig. 1. The lock can be secured to the wall beside the telephone

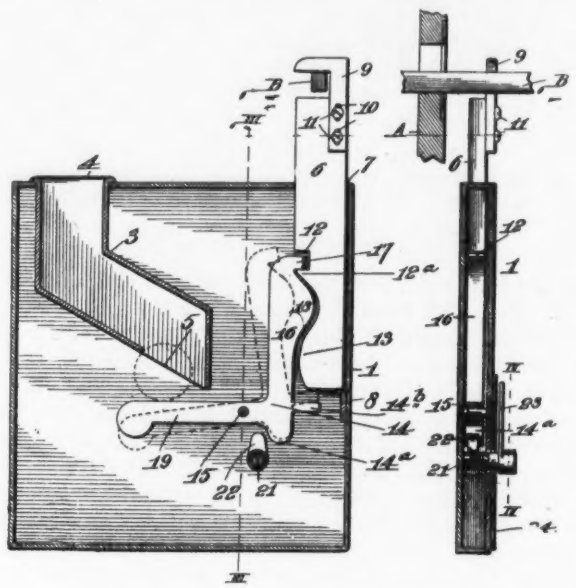


FIG. I.—HEAD COIN LOCK FOR TELEPHONE HOOK.

instrument with its hook or bolt engaging the telephone switch lever, shown at *B*, in a manner to lock it in the depressed or non-calling position. As clearly shown, the bell crank latch must be tilted to release the bolt before a call can be sent to the central office. Two means of tilting it are provided. The first of these is for the use of the general public and consists of a coin slot wherein the proper coin may be deposited for the benefit of the subscriber. The second means is a dial and pointer. This is for the use of the subscriber, and is so arranged that when the pointer is placed upon the proper number of the dial the bolt is released. This number is naturally one of the "trade secrets" of the particular store in question. Of course, it is possible for unscrupulous persons to find the key number by trial, but such a process will be evident to the subscriber, who will probably be able to impress upon the offender without embarrassment the legitimate operation of the apparatus.

Some time ago the "lazy tongs" was assigned a use in telephony in a patent for a train system wherein it formed a flexible connection between the train and the line wire. In the patent issue of April 21 it again appears, this time as the adjustable part of a receiver holder. One end of the lazy tongs is swiveled to a base, while the other carries a cross-bar bearing the usual spring, receiver-holding clips. The inventor pivots the receiver cross-bar about an axis parallel with the line of extension of the tongs, and provides two mountings for it, so that the receiver clips may be either parallel to or perpendicular to the axis. This arrangement forms the basis of the claims, which are very broad. The holder has the usual defect of removing the semi-automatic action of the hook switch. The inventor of this device is G. Königstein, of San Francisco.

A second telephone patent of the issue of April 21 provides a special method of wiring strips of lamp jacks for telephone common-battery switchboards. This patent is granted to Henry P. Claussen and is assigned by him to the American Electric Telephone Com-

pany. The continual diminution of the space assigned to jacks, in modern large telephone switchboards, has made the allowable clearance between the parts of adjacent apparatus so small that with the usual method of wiring wherein these adjacent parts are connected to opposite polarities, the danger of short circuit with its consequent troubles is very great. By Mr. Claussen's method, the order of wiring alternate jacks is reversed. The proximate springs of adjacent jacks are thus of like polarity, thereby rendering a short circuit between any two of little effect.

The third patent of this issue has been secured by Charles E. Scribner, of Chicago, and is assigned to the Western Electric Company. This patent describes a novelty in spring jacks, as a clamping split sleeve is used for one of the plug-engaging terminals. Fig. 2

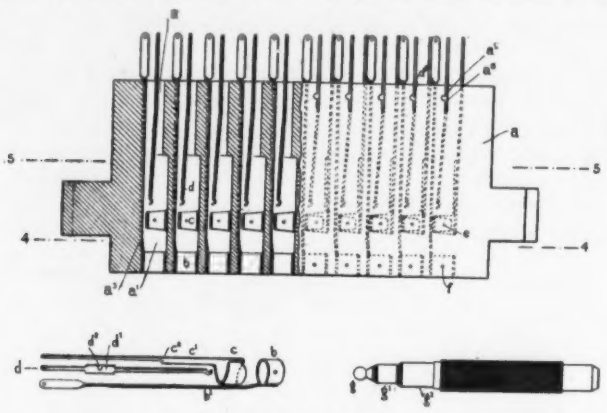


FIG. 2.—SCRIBNER SPRING JACK.

shows the jack strip, jack terminals and the plug of the kind described. The chief advantage claimed for the split sleeve terminal is that its use permits an extremely cheap construction for the jack strip. No milling of the rubber blank is necessary, the working consisting entirely of drilling and sawing. Four holes are required for each jack, as follows: a^1, drilled from the front, of a size to take the usual thimble; a^2, eccentric with a^1, and of slightly smaller diameter; and two small holes, a^3 and a^4, serving to lead the thimble and sleeve terminals to the back of the strip. As may be seen, the thimble, *b*, registers with the plug sleeve, g^2, the split sleeve, *c*, clamps the plug part, g^1, while the spring, *d*, engages the tip, *g*, in a manner to hold the plug home in the socket. As the milling of the rubber strips is the most expensive work on rubber jack strips, the present type should effect a considerable saving in cost.

Independent Long Distance Lines in Indiana.

The Allied Independent Toll Company, with the Home Company as a nucleus, was formed at a meeting in Indianapolis on April 14. The organization is made up of about 20 independent companies of Northern Indiana and Eastern Illinois and will be incorporated. The object is to perfect a system of toll lines throughout Northern Indiana and Eastern Illinois to compete with the Bell Telephone Company. Walter J. Uhl was elected president and Henry Barnhart, of Rochester, secretary. Three cable lines to South Bend, to Wabash and to Remington, from Logansport, will be constructed. The movement is regarded as significant of the betterment of the long-distance service in that territory. A large number of well-known telephone men were present at the meeting. Another meeting will be held May 11 to complete the organization and file articles of incorporation.

German Electrical Industry.

Reports to the State Department as to the profits of the leading industrial undertakings in Germany for 1902 show that the average dividend paid by the electrical enterprises in 1902 was 4.13 per cent., as compared with 5.92 per cent. in 1901. In machine manufacture the rate in 1902 was 4.77 per cent., as compared with 6.13 in 1901. The electrical figures are understood to apply to manufacturing enterprises as distinguished from local companies; but this is not specifically stated. The remark is made by United States Consul Albert: "It is generally believed that the turning point in the business depression in Germany has been reached, if not passed. Many corporations which had fallen into financial difficulties have been reorganized and put once more upon a stable foundation."

CURRENT NEWS AND NOTES.

PACIFIC CABLE.—Secretary Root has granted permission to the Pacific Commercial Cable Company to land its line on the military reserve near Fort San Antonio, Philippines, and to erect a cable station there.

TELEGRAPHS IN MANCHURIA.—It would appear that dispute has arisen over certain points connected with the Russian occupation of Manchuria, but the government of the Czar is understood to deny having made demands on China that are attributed to it. One of these is to the effect that Russia is entitled to attach telegraph wires to the poles of all Chinese lines in Manchuria. This is said to be false.

LODGE VS. MARCONI.—A report comes from London through newspaper channels that Sir Oliver J. Lodge may sue Marconi for infringement of his (Lodge's) wireless telegraph patents. Lodge contends that Marconi's vertical radiator, his coherer and other essentials are infringements. In this connection Mr. Nikola Tesla is reported to have said that the dispute between Lodge and Marconi does not involve his own patents, as they are entirely distinct from either. "We are working in diametrically opposite directions," he said.

N. E. L. A.—Mr. C. O. Baker, Jr., master of transportation, writes us: "I take pleasure in advising you that the New England Passenger Association, the Trunk Line Association, the Western Passenger Association and the Southeastern Passenger Association have granted a rate of a fare and a third, on the certificate plan, from all points in their respective territories to Chicago and return for members and delegates attending the twenty-sixth convention of the National Electric Light Association, to be held in Chicago May 26, 27 and 28."

ST. LOUIS EXPOSITION opens with great ceremony this week, on April 30, when President Roosevelt will deliver a dedication address. The Engineers' Club of St. Louis visited the World's Fair grounds April 18. They assembled in the chapel on the second floor of the Administration Building, where brief talks were made by President Francis and Director of Works Taylor. The club then made a tour of the grounds in an observation train composed of an engine and three gondola cars. The members, including a great many electrical engineers, were highly pleased with what they saw.

PENNSYLVANIA RAILROAD TUNNEL.—President A. J. Cassatt, of the Pennsylvania Railroad Company, has appointed an advisory committee of experts to assist in the work of constructing the New York fifty-million-dollar tunnel. The appointees are Theodore N. Ely, chief of motive power of the Pennsylvania Railroad, chairman; W. H. Baldwin, president of the Long Island Railroad; S. D. Newhall, purchasing agent for the Pennsylvania, and A. W. Gibbs and A. S. Vogt, general superintendent of motive power and chief mechanical engineer for the Pennsylvania Railroad. The committee of experts has already decided to adopt for use in the tunnel an electrical engine, the motor of which will rest on a truck, so that it will only be necessary to increase the number of trucks to obtained increased power.

CUTTING A GOVERNMENT TUNNEL.—After only twelve days of usefulness, the United States Government submarine cable connecting the Farallon Islands with the mainland at Point Reyes has been severed. It was cut last Sunday afternoon, April 26, either accidentally or deliberately, by the crew of the steamer South Portland, which had put into Drake's Bay during the previous night to escape the northwest wind that was blowing at the rate of sixty miles an hour. It is presumed that the steamer's anchor picked up the cable near Chimney Rock, which marks the land end of the line, and that Capt. Hornsman gave orders to sever the cable rather than see the anchor lost. A report of the matter has been sent to Washington, and it is possible a suit will follow in the Federal Courts against the owner of the steamer. Facilities for grappling and splicing the cable are available.

BEDS OF RADIUM.—A funny dispatch from St. Petersburg in the New York daily newspapers alleges that "a Russian engineer is said to have discovered a bed of radium in a remote and uninhabited region of Siberia." The man who discovers mines of radium *au naturel* deserves encouragement.

PARIS TUBE EARNINGS.—A cable dispatch from Paris of April 25 says: "The annual report of the Paris General Omnibus Company shows the effect of the Paris Metropolitan Underground road on other methods of locomotion. The receipts in 1902 were about $200,000 less than the previous year and $1,400,000 less than in 1899. The number of passengers decreased 18,000,000. Fifty omnibus and tramway lines are being run at a loss."

AMERICANS IN GERMANY.—A cable dispatch from Berlin of April 25 says: "Because of the high German tariff many American manufacturers are considering the advisability of erecting factories in Germany. To-day the Carborundum Company, of Niagara Falls, announced its intention to build works in Prussia. The Westinghouse Electric Company and the Worthington Pump Company are deliberating similar steps. The establishment of factories in Europe is becoming necessary because European manufacturers are adopting American methods so extensively that the main advantage which the Americans are enjoying is gradually disappearing."

WIRELESS TELEGRAPH IN ALASKA.—In view of the recent discussions as to the delay in installing the proposed wireless telegraph plant in Alaska, it is interesting to note that Engineer Richard Pfund and his assistant, Herbert C. Welby, of the Marconi Wireless Telegraph Company, of America, have started for Alaska to complete the installation there of a series of wireless telegraph stations for the United States Signal Service. The apparatus originally sent to Alaska and left in charge of Stanley Cook, of the Marconi Company at Fort Gibbon during the past winter will be returned, and new apparatus substituted for it. Upon arrival at Seattle the party will arrange for the shipment of the new apparatus to Alaska. It was forwarded to the Pacific Coast some time since. With Fort Gibbon in Alaska as the starting point, the first station there will communicate with the second at Tolovana, distant approximately 100 miles. The third and last station is at Chena, on the Tanana River, 100 miles up the river from Tolovana. The Tanana flows into the Yukon at Fort Gibbon, and its general course is northwest. The stations are all located at army posts, and will be operated by Signal Service operators. It is expected that the system, the first of any consequence to be installed for overland transmission, will be completed and turned over to the Government about August 1.

LETTERS TO THE EDITORS.

A Theory of Magnetism.

To the Editors of Electrical World and Engineer:

SIRS:—You very kindly published my theory of magnetism in your issue of December 20 last year, and in the meantime I have finished the whole work and I am now able to give the following brief and chief "laws":

1. Iron as a shell or siding of an electromagnet outside the solenoid does not become polarized, but is only a protection.

2. Long arms or shoes at the free ends of magnets are not so-called poles, but concentrate the power between them, the poles existing only at the ends of the solenoid.

3. Iron near a magnet outside of a solenoid does not become a magnet, but is an obstacle or a resistance to the magnetic force which is directed to the poles.

4. The magnetism is an electrical force and not a special "magnetic" force.

5. The magnetic phenomena imply electrical pressure.

6. The electric and so-called magnetic phenomena follow the ordinary and well-known mechanical laws; there are no special laws, no attractions nor so-called unknown phenomena.

7. In a magnetic field there are not both pressure and attraction, but only electric pressure.

8. The force of the magnetism of steel exists only in the surface of the material; it is a skin effect.

9. The magnetic forces or waves can be derived, dispersed or refracted like electrical or light waves; all three have the same motive source—the motion of the ether.

Everyone can prove these points by experiments. They are not theory, but facts, and the old teaching was a phantom.

CHARLOTTENBURG, GERMANY. JOH. ZACHARIAS.

Stress on Frames of Alternating Current Generators.

To the Editors of Electrical World and Engineer:

SIRS:—In your issue of April 11 I read with much interest that Mr. P. J. Frenell is not satisfied with the answer given by Mr. A. Hansson to his paper having the above title. On the contrary, he upholds his former opinion and considers it wise to calculate a frame with relation to stress instead of deflection, and he declares that he will be satisfied if any designer has received any practical benefit from his article.

I would like to state that Mr. Frenell has made a fundamental error, and in my opinion any designer who has applied his theory will very soon find its drawbacks. He writes that deflection and stress are different subjects. That is true, but they are fully dependent on one another, and the greater the stress at any point of a construction, the greater also the deflection or, as it is generally called, the deformation in such a place.

According to American practice, the frames of large electrical machines must always be designed for a very low stress, as a low deflection is essential; and I can only understand that the object of Mr. Frenell's paper is to illustrate that the laws of strain and elasticity are right not only for any other machine, but also in the special case of frames of alternating-current generators. As soon as Mr. Frenell uses such large differences of air-gap as he recommends he will also get greater stresses in his armature frame. But I am afraid he would have trouble with that machine. The admissible difference in the air-gap of a machine is not so great as Mr. Frenell claims, and its true size can always be determined only by means of the characteristic curves of the machine.

Mr. Frenell refers to a special machine, considered in the paper of Mr. Linsenmann in the *Elektrotechnische Zeitschrift.* Mr. Linsenmann gives an air-gap all around of 6 mm, the induction of which is 8,650 gausses. If the air-gap, according to Mr. Frenell, is at one point 1/16 in., 1.6 mm larger than at the other, the air-gap is 5.2, or 6.8 mm, and we find from Mr. Linsenmann's curves the induction with 9,050, or 8,200 gausses. The magnetic pull, therefore, is on one side 2.7 kg and on the other 3.3 kg per cm^2, and consequently this magnetic pull has a variation of 22 per cent. That is, at the point where, owing to deflection, we get the smallest air-gap, we have the greatest magnetic pull; and this difference in magnetic pull will enlarge the deflection until equilibrium is reached. In this case the stress in the armature frame will get higher than is common practice and it may be that it reaches a value corresponding to that which Mr. Frenell desires to get; but it is my opinion that the machine would not run satisfactorily and might perhaps reach a point where it is inoperative.

As the flux in the revolving field would vary about 22 per cent., as mentioned before, we would also have a loss by hysteresis in the field iron, and the efficiency of the machine would not be as high; but the loss would be insignificant. This is a small drawback, which probably would not prohibit this great variation in the air-gap.

I agree with Mr. Frenell that the theory in Mr. Linsenmann's article is somewhat elaborate, but its application is very simple. I wish to state this from experience, as I used it immediately after its publication.

If the characteristic curve of a machine is not obtainable, the deflection can generally be made as large as 1/40 of the single air-gap. I consider this a pretty good value for deflection in general, and prefer it to another formula which I used about 10 years ago. If D is the diameter of the machine in mm, taken at the air-gap, then the admissible deflection was $D + 1{,}000 \div 5{,}000$. At that time only machines of smaller sizes were made and then this formula held good; but with the large dimensions of the machines of to-day the deflection would be more than can be allowed.

I agree fully with him that the armature frames of American machines contain too much inactive material. The enormous waste of material can best be seen if we examine the large frames turned out by the principal American firms where the thickness of material

is sometimes as much as 2½ in. to 3 in. It would not at least be difficult to make a frame just as stiff or even stiffer with considerable less weight. The weight can always be reduced so far that care must be taken that the frame does not break in shipping. This would, of course, alter the construction also.

As Mr. Hansson has previously said, European manufacturers are far ahead of Americans in this line, as the prices of material are higher and standardization is not as far advanced there. You have several times criticized the American railway practice with its "scores of sub-stations with rotaries—nice, steady-going, low-speed rotaries all thoroughly standardized and fed from giant transformers to match." American alternating-current machines are similarly standardized. Years ago this standard was developed for a machine of small diameter, and to-day machines of by far greater diameter are made in the same way. European manufacturers have done differently, and as early as 1894 the well-known firm of Brown, Boveri & Co., of Baden, Switzerland, made single-phase machines for the municipal plant at Frankfurt (5,500 mm diameter at the air-gap), with a system of arms inserted in the armature frame instead of making the frame self-supporting. And in 1896 the Schuckert Company, at Nüremberg, began stiffening their machines by inserting tension rods in the armature frames something like the construction of a bicycle wheel. Machines of both constructions—Brown, Boveri and Schuckert—could be seen at the last Paris Exhibition. Later the A. E. G. developed its system of stiffening the armatures, and to-day one can say that the stiffened armature is a familiar construction with all European manufacturers. This is a matter of course, since developing machines of great output in Europe was always along the lines of slow-speed, while in this country more high-speed machinery, owing to our many water powers, was developed. And I believe this to be the reason why here the girded or stiffened armature frame is not yet used. Our manufacturers have not yet given their attention to this construction, as they have been engaged with high-speed machinery, and at the present time they are considering still higher speeds since the turbo-dynamo has become an issue.

If Mr. Frenell has actually applied his theory, I would be glad to hear something about his results.

PITTSFIELD, MASS. FREDK. W. KNOPFE.

Sweden and Electric Railway Development.

To the Editors of Electrical World and Engineer:

SIRS:—I have noticed with interest the report of Mr. Dahlander submitted to the Royal Swedish Railroad Administration, which was published in full in the *Tecknisk Tidskrift* and abstracted by Mr. Westerberg in your issue of March 21, 1903. The fact that Mr. Dahlander reported in favor of the adoption of my system for the replacement of the steam locomotives is, of course, very gratifying to me.

It is interesting to note that this Swedish report looks upon the single-phase alternating system as the only commercial method of operating a trunk line railway system. I believe that I was the first engineer to insist, in 1891, that the single-phase alternating-current system was essential to success in this direction. The establishment of a single-phase alternating system of 25 periods for the Swedish railways will enable the government to employ either my locomotives or any other form which may be developed. The essential differences in the several single sysfems which are seriously considered to-day for heavy railway service are met with in the methods and means employed in the locomotive itself for utilizing the energy of the single-phase current.

There are three principal classes of duties in railway work, as follows:

1. Heavy freight haulage over existing railroads; in which economies are proportional to the increase in the tractive effort obtainable in a single locomotive under perfect control.

2. Rapid-transit passenger service in and about large cities; in which the most important factor is the smoothness with which the trains can be accelerated to a very high speed.

3. Long-distance, high-speed passenger service and interurban passenger service; in which rapidity of acceleration becomes unimportant and in which light-weight, high-powered, individually-equipped cars should be used.

The essential characteristics of these three classes of railway service are so pronounced and different that it would not be surprising to find each class employing a particular system best adapted to the requirements of that class of service and not employed in the other classes of service.

For example, the long-distance, high-speed passenger service seems likely to be handled by the directly-employed, single-phase, alternating-current motor.

On the other hand, I feel the greatest confidence that my electric locomotive system will be found the best adapted to the haulage of freight on existing railways where the heaviest possible locomotive is demanded, and where simplicity and perfection of control under wide ranges of speed and torque are of vital importance.

As to the rapid-transit passenger service in and about cities, it is much less easy to predict what system will eventually prove to be best adapted to this class of service, on account of the many factors entering into this problem and the difficulty of giving at this time to each factor its proper relative value in importance. I believe, however, that some system which will smoothly apply, and continually maintain, during the period of acceleration, a torque just below the limit imposed by skidding, will supplant for such service the present series-parallel system of series motors by which the passengers have been already jerked to the limit of endurance, without even then securing a speed of acceleration at all comparable with that attainable by a continually-sustained constant torque just below the skidding point.

It may interest you to know that recent data received by me from the Oerlikon Company indicates that my electric locomotive system will, before long, see such a complete commercial demonstration in Switzerland as will be quite conclusive as to its value for freight service on trunk-line railways.

I observe that the Swedish report shows the entire cost of operation of 2,691 miles of railway requiring 102,000 hp to be only one-half of the cost of operation of the present steam locomotive system, figuring coal at the average price for many years past. The report shows a net saving for my system over the present steam-operated railways of $2,000,000 per year. In figuring the cost for the Leonard system all interest charges on the investment, together with a liberal sinking fund and all other proper charges of cost were included.

In view of such figures as these from a thoroughly competent and entirely disinterested engineer, and the evident faith of such an experienced concern as the Oerlikon Company, it is apparent that the articles we frequently see in the American press as to the practical impossibility of commercially operating by electricity a trunk line railway must be inspired by the electric railway monopoly which owns controlling patents on the conventional trolley system and, like all monopolies, strives to prevent the development of any ideas not controlled by it.

It is to be hoped that before long some American steam railway company will prove to be as progressive as the Swedish Government and the Swiss Government, and that Mr. Dahlander or some equally competent and independent engineer may have a chance to see whether American inventions are not just as applicable for use in America as they are abroad.

The most authoritative and conclusive figures as to the first cost and efficiency of the familiar sub-station system are contained in Bulletin No. 131 of the Stanley Electric Manufacturing Company, entitled "The Rotary Converter in Interurban Railroad Work." This bulletin was issued October 8, 1902, a few months before the absorption of the Stanley Company. It contains a fair and unbiased statement of the sub-station system and the figures were taken from the latest and best installation. The sub-stations are located twenty miles apart, so that the section normally fed by a sub-station is twenty miles. The schedule provides for two cars in a section, each car having an equipment of four motors, rated at 50 hp each. There is a high-tension alternating-current transmission and a working circuit of 600 volts, as usual.

The copper in the working circuit averages 750,000 circular mils, costing $34,000 per section, or $85 per motor-hp. The first cost of the sub-station is $20,000, or $50 per motor-hp, and the cost of operating the sub-station is equivalent to the interest on $20,000, so that the total capital represented by the sub-station and low-tension copper is $185 per motor-hp. The comparable portion of my system is the motor-generator, the first cost of which will not exceed $30 per motor-hp, or only about one-sixth as much.

As to relative efficiencies: If we grant 95 per cent. efficiency for the rotary and 65 per cent. for the low-tension circuit, we have an

efficiency of 62 per cent. for the sub-station system between the high-tension circuit and the motors, while with the Leonard system the efficiency of the motor-generator will be not less than 83 per cent. The high-tension generators of the sub-station system must be at least one-third larger and more expensive than needed for my system in order to provide for this excessive loss in the low-tension circuit.

Just as long as American railway directors will blindly purchase sub-stations and series-parallel controls at several times the first cost and three-quarters the efficiency of other available long-distance systems, there is little hope for progress in serious heavy railway work in this country, until the successful application of American inventions on foreign railways forces upon their attention the fact that the monopoly in the electric railway field has prevented for many years the development in this country of the most important and valuable branch of electrical work, namely, the operation of our trunk line railways by electricity.

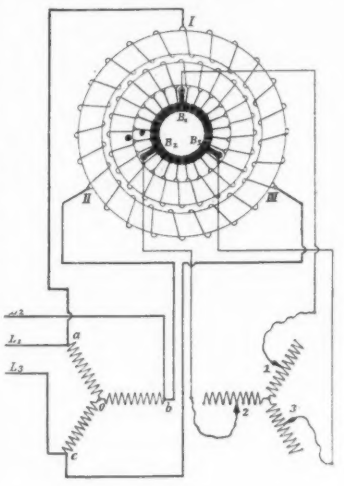
H. WARD LEONARD.

BRONXVILLE, N. Y.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Speed Regulations of Induction Motors.—WINTER.—An illustrated paper read before the Vienna Electrical Society on three-phase induction motors with adjustable speed, devised by Winter and Eichberg. If a direct-current commutator winding is used on the rotor, there exists at fixed brushes connected to the commutator, an e.m.f. of the frequency of the stator field, this frequency being independent of the speed of the rotor. This property of the direct-current winding in the rotor enables one, with the aid of a stationary transformer, to return the rotor energy to the network and thus make use of it; reversely it is possible, to change the speed at will by varying the e.m.f. at the rotor brushes. If the field is constant, no stray field being present, then the e.m.f. produced in the rotor of an ordinary induction motor, is directly proportional to the speed of the stator field relation to the rotor, i. e., proportional to the frequency of the rotor currents. The conditions of a motor with a direct-current armature are similar. The e.m.f. at the fixed brushes is also directly proportional to the speed of the field relation to the rotor, but it has a constant frequency. If the rotor is held at rest, there exists at the brushes an e.m.f. equal to the stator e.m.f. When the rotor begins to revolve, the. e.m.f. gradually decreases and becomes zero at synchronism; with increasing over-synchronism the e.m.f. at the brushes again increases. If a certain e.m.f. is impressed on the rotor through the fixed brushes, then the rotor must revolve with a speed at which a counter e.m.f. of equal value is produced by slip in the magnetic field. The rotor will maintain this speed as long as the voltage at the brushes is kept constant; although the ohmic and induction loss in the windings produce variations from the exact rule. The adjoining diagram shows a bipolar three-phase stator winding in the form of a Gramme ring, and a bipolar rotor winding in the form of a direct-current armature with commutator. The currents are supplied to the stator through the points *I, II, III,* and to the rotor through the three brushes, *B*. If the ratio of both windings is unity, the three-phase e.m.f. at the brushes is the same as at the points *I, II, III*. If the position of the brushes is such that the phases of the rotor e.m.f. are in approximate agreement with those of the stator e.m.f., then the brushes may be connected to an ordinary transformer, as shown in the diagram. The primary of this transformer is generally connected to the conductor leading to the points *I, II, III,* while the secondary is connected with the three brushes, *B*. If the e.m.fs at the brushes, *B*, are chosen greater or smaller than the e.m.fs at *I, II, III,* the rotor will revolve and will assume such a speed that the e.m.f. generated in it, is equal to the applied e.m.f. If the above voltage is greater, the rotor revolves in the direction opposite to the revolving field; if smaller, in the same direction. At zero voltage it tends to reach synchronism. With a proper position of the brushes and gradual increase of voltage, the rotor also revolves with a speed above synchronism. The speed regulation may be obtained as well by varying the stator voltage as by varying the rotor voltage, i. e., in general by varying the difference. In practice it is best to work with small phase difference, i. e., with a high power factor. Two experimental motors of this type have been tested and have shown the correctness of the theory.—*Zeit. f. Elec.*, April 12.



SPEED REGULATION OF INDUCTION MOTORS.

Non-synchronous Single-phase Alternating-current Motors.—GEORGES.—An article in which he first refers to the theories in which a single-phase alternating field is considered as the resultant of two rotating fields of equal intensity, revolving in opposite directions; theories of the induction motor, based on this supposition, are inexact and not very clear. He refers to another theory developed by Potier and himself, the fundamental principle being the assumption of a component of the magnetism perpendicular to the main field and proportional to the speed of rotation; he thinks this theory gives more exact results for the calculations of motors. As it has so far been given only in an analytical form, he explains it in the present article by means of dynamos, and assumes a bipolar motor, but remarks that it may also be applied to multipolar machines. The main results obtained by him are as follows: The main field generates a second field, nearly perpendicular to it and proportional to the speed; at synchronism its intensity is nearly the same as that of the main field. This second field generates e.m.fs which increase with the square of the speed and tend to decrease the current in both rotor and stator and may, therefore, be considered as counter e.m.fs. The torque varies as the sine, with double frequency between a greater positive maximum and a smaller negative maximum. The main field generates directly only a negative average torque, the power of which serves to compensate for the losses involved in the generation of the second field. At synchronism this is the only torque which exists. The positive mean torque is produced by the second field; to make it a maximum, it is necessary that the armature resistance should be very small. A speed regulation within wide limits is impossible by inserting resistance in the secondary circuit. At rest the instantaneous value of the total torque is zero; the mean total torque passes through zero before synchronism is reached. If the speed is increased above synchronism, both average torques become negative; the one corresponds, as before, to the compensation for the losses involved in the production of the second field, the other corresponds to power furnished to the actual circuit; the motor, therefore, acts as a generator above synchronism.—*Elek. Zeit.*, April 9.

REFERENCE.

Small Generators for Automobile Purposes.—In the conclusion of the illustrated article on the recent automobile exhibition in London, several types of a small generator are described and illustrated, which may be used either for charging batteries on a motor car, giving a practically constant current at variable speed, or for firing the ignition directly without batteries.—Lond. *Elec.*, April 10.

LIGHTS AND LIGHTING.

Arc Lamp.—An illustrated article on the recently opened lighting system of Hornsey and on the construction of the arc lamps which are installed there. There are at present 50 arc lamps, connected in series of five across from the neutral to either one of the outers of the 480-volt, three-wire system of distributors. The lamps are

of the "Angold band-brake pattern," rubber pads being used for the brake band by an arrangement which gives a steady feed and compensates for the wear of the rubber. The brake drum carries the band, which is furnished with rubber pads, one end being attached to a pulley controlled by a spiral spring in tension, and the other end hooked on to a working frame controlled by the two cores; the tension of the spring takes up any slack of the band as well as any slack that may be caused by the wear of the pads; this keeps the brake in action, and maintains the position of the band relatively to the drum. Regulation is effected by a pawl controlled by the rocking frame, which engages a toothed sector mounted concentrically on the pulley to which the band is attached. When the mechanism is at the predetermined feeding point, the pulley comes into action and the spring can no longer exert a pull on the brake band, feeding, therefore, takes place. When compensation is necessary the pawl rotates somewhat farther before all the slack is taken up; consequently, when the feeding point is reached, the pulley engages a different tooth. The regulation remains constant and independent of wear, because the release of the brake always occurs when the mechanism takes up a certain position. The suspension gear in use and the differential cut-outs are also described.—Lond. *Elec. Rev.*, April 10.

Power.

Three-Phase Motors in Factories.—Eborall.—A paper on the application of three-phase motors to the electrical driving of workshops and factories, read before the Society of Arts. A three-phase installation for most classes of work is preferable to a continuous-current one, owing to its flexibility, reliability and economy in cost of installation and maintenance; its ability to stand overloading and rough treatment cannot be equalled by direct-current machinery. Its only disadvantage is when economical speed regulation is required. He discusses the starting current of induction motors and the use of squirrel-cage armatures and armatures with slip-rings. Generally speaking, economical speed variation is of minor importance in workshops and factories, as the shafts are driven at practically constant speed; and in machine shops only the cranes need considering from a speed regulation point of view, and the difference in efficiency in this matter between three-phase and direct-current motors would be inappreciable in the consumption of coal. For traveling cranes the motor of the cross traverse may be of the short-circuited rotor type; for textile mill driving three-phase motors meet the conditions better than direct-current motors do; for cotton and woolen mills the best arrangement is to drive groups of machines from one motor; for silk weaving, individual driving of the looms is the ideal method. In general he lays down the following rules for three-phase installations. The pressure drop in the generators should not exceed 16 to 18 per cent. from no load to full load, at constant speed and excitation, according to size, the full load power factor being taken as 80 per cent.; high engine speed is favorable to good performance in this respect. The power factor of the motors should be as high as possible over a wide range of load; above 3 hp this should be not less than 80 per cent. from half load up, and a flat power factor curve over the working range should be insisted on. The efficiency curve should be as flat as possible over the working range of load. A proper starting performance should be insisted on, and short-circuited rotors should be installed with discretion in the larger sizes.—Lond. *Elec. Rev.*, April 10.

French Hydraulic Power Station Statistics.—Coignet.—A long table giving some statistical data on hydraulic stations in France, stating what they are used for, where they are located, the height of the fall and the hydraulic power *"en poncelets"* (presumably in horse-power). There are three aluminum plants, power, 16,802; 5 electrometallurgical plants, power 15,166; 2 potassium chlorate plants, power 6,750; 15 calcium carbide plants, power, 72,063; 1 sodium and chlorine plant, power, 10,125; 21 stations for distributing electric power and light, power, 28,067; 22 printing and paper mills, power, 9,551; 4 textile mills, power, 695; 1 saw mill, power, 60; 6 cement factories, power, 1,913; 2 potteries, power, 151.—*L'Ind. Elec.*, April 10.

References.

Electric Capstan.—An illustration with a brief description of an electric capstan for drawing ships into the dock; it is operated by a 30-hp motor.—*Eng'ing*, April 10.

Oregon Power Transmission.—A well-illustrated descriptive article on the "White River-The Dalles" electric power transmission.—*Jour. of Elec.*, March.

Traction.

Boosters.—In an illustrated descriptive article on the South Lancashire tramways, the following auxiliary machines are mentioned which are installed in the power plant in connection with the boosting arrangements and for battery charging, these including a positive feeder booster of 56 kw, two 8-kw negative feeder boosters, a "milking booster" for 240 amp. and a 40-kw "reversible booster." All these machines are driven by shunt-wound motors operating at 500 volts. The reversible booster is of special construction and is capable of working at 240 amp. and 130 volts when the battery is being charged, and 70 volts and 576 amp. when the battery is discharging. The reversible boosting process is carried out automatically in accordance with the requirements of the service, the arrangement

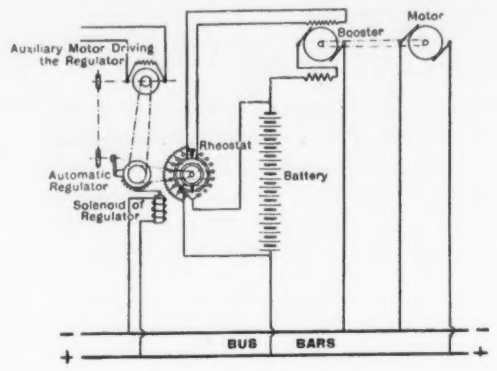


DIAGRAM OF BOOSTER CONNECTIONS.

being shown in the adjoining diagram. The booster armature is in series with the battery across the bus-bars, and the reversal of the e.m.f., together with the regulation of the pressure to the correct amount in either direction, is effected by means of a regulator, consisting of a regulating resistance for the shunt field of the booster, in conjunction with a reversing switch, both of which are operated by a small auxiliary electric motor. The motor runs continuously in one direction and drives a mechanism which cuts out and reverses or introduces resistance into the field of the booster, the speed and the reversing being controlled by means of a solenoid, which is governed by the bus-bar voltage. Thus, for instance, the contact arm of the shunt resistance in the booster field circuit moves in one direction and introduces resistance into the booster field circuit, then at a certain point in its travel it reverses the connections on the booster field, and cuts out resistance as required, in order to keep the bus-bar voltage constant. This varies the strength of the booster field in either direction, and assists or opposes the battery current, in accordance with the requirements of the external load. The rate at which this arm travels over the contacts is extremely rapid, the time taken to move completely around the dial, i. e., from the maximum charge in the battery to the maximum discharge, being something like 15 to 20 seconds. The particular direction of rotation of this arm is governed by the solenoid through a simple trip mechanism.—Lond. *Elec.*, April 10.

Electrical Traction in Steam Railways.—Adams.—An article in which the author says that the difference between supply to distributed loads (as on tramways) and to concentrated loads (as on railways) is the main barrier to electric traction on steam railways. In a system of high voltage transmission and converter sub-station the cost of the converter sub-stations become prohibitive. He cites several European three-phase traction systems and one in Michigan, where the cars take high tension single-phase from the trolley wires and transform to low pressure for the motors. He concludes that whether the advantages of electric traction warrant a change from steam to electric traction, it seems certain that electric traction can displace steam locomotives for thorough traffic only if each train carries its own sub-station.—*Cassier's Mag.*, April.

Interurban Electric Railways.—Gonzenbach.—The conclusion of his serial on engineering preliminaries for an interurban railway. He deals first with accessories, including telephones, block-signal system, passenger stations and provisions for flag stops. The telephone has come to be accepted very generally for train dispatching and is pronounced superior to the telegraph for this purpose. It is pointed out that an automatic block-signal system is essential for the safe operation of a road of this character, and it is contended that there is now no justification for failing to employ apparatus

of this description. An outline of a station platform suitable for a flag stop is illustrated. Special provisions for lighting waiting stations, highway crossings, switches, etc., are recommended, and it is suggested that a single galvanized wire which runs the entire length of the road be employed with the lights attached to this in series of five; these circuits could be turned on and off from the sub-stations. Where it is proposed to supply lighting and power, it is recommended that instead of purchasing outright the existing plant and using its system, as has frequently been done, an entirely new layout be provided, to consist of an alternating-current series arc light system, four-wire secondary system, in the business streets of small towns and groups of houses fed from one transformer in residence lighting. Considerable revenue may be derived from this service, while the additional investment in operating cost would be comparatively light. An estimate of the cost of building a road according to the plan here outlined is presented in detail, but no allowance is made for right of way, franchises and local expenses, as these are all determined largely by the locality. The operating expenses average 55 per cent. of the gross receipts. A summary of the recommendations made and a comparison of some recently established properties shows that less money should be invested in electrical equipment, power houses, transmission line, sub-stations, track rails and third rails, while more should be invested in track ballast, car bodies, trucks, block-signal system and waiting stations. Attention is further called to the lighting and power supply business as a means of utilizing the by-products of electric railway power stations, after the manner of the gas companies.—*St. R'y Jour.*, April 4.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Alternating and Direct-current Systems.—C. F. SCOTT.—A general discussion of the general problem of alternating current versus a combined alternating and direct-current system. Pure direct current cannot be used in many cases; alternating current must be used and the question is whether in those cases in which the conversion from alternating into direct current is commercially practicable, it is necessary or desirable. All of the important classes of service for which current from a central station is used may be undertaken in general equally well by direct or by alternating current; the only exception is that of variable-speed motors, in which case direct current is preferable. In the apparatus used in the stations, the principal difference lies in the expensive converter sub-stations required in a combined direct and alternating-current plants. This conversion also increases the liability to accident and interruptions. While the storage battery is often quoted as an element in favor of direct current, the author suggests that in an alternating current a rotary converter may be employed for charging the storage battery, and in turn the battery can supply current through the converter to the alternating-current circuits. Concerning the practical problem as to which system should be employed in any and every case, he remarks that there is no ideal system and no panacea which can be universally applied, as existing local requirements must be taken into account.—*Cassier's Mag.*, April.

High-Tension Switching.—An illustrated description of the sub-station of the Butte Lighting & Power Company, at Butte, Mont., where power is received from the transmission line of the Madison River Power Company, a building of 50 by 100 feet in size, being exclusively devoted to the purpose of high-tension switching, fusing and transforming. The receiving end of the system in Butte is laid out for the handling of 80,000 volts, and for a few hours the transmission has been operated very satisfactorily; but as the load has not yet been sufficient to warrant extensive experimenting at such a high pressure, 40,000 volts have been used up to the present. The transformers in the Butte sub-station are described in detail. The same issue contains an extended and well-illustrated description of the Butte County gas and electric systems.—*Jour. of Elec.*, March.

High-Tension Fuse.—GARRARD.—An illustrated article in which he describes an oil fuse for 11,000 volts and 1,500 kw. The fuse pot is 18½ in. high and consists of a porcelain vessel divided down the middle by a partition; over this division hangs a porcelain saddle, with projecting cross-pieces, which divide the whole pot up into eight compartments; there is no lid, the pot being open to the air. The current is led in and out by two contacts, which are near the bottom, and make metallic connection on each side to a spindle, on which are four drums wound up by steel spiral springs fixed inside them. The flexibles which reach through the oil to the top of the middle partitions are fixed to the outside of these drums and when pulled to the top, wind up the springs. The copper fuse wires, which are about 1 in. long, are soldered to the ends of these flexibles; when these fuse wires melt, the flexibles are drawn down sharply into the oil by the springs inside the drums and the arc is extinguished on the top of the oil. The effect of the arrangement is that there are four fuses in parallel. Some tests with this type of fuse are noticed and it is claimed to be absolutely reliable.—Lond. *Elec. Rev.*, April 10.

REFERENCES.

Electric Legislation in India.—An article giving the most important portions of the "Indian Electricity Act" which was recently passed. It is well spoken of editorially; the privileges and rights of the public appear to be fully safeguarded, while at the same time a number of the irritating and hampering restrictions in force in England have been abandoned. The act deals with the procedure in the case of undertakings supplying electrical energy for traction or to the public, with factory installations, etc.; rules, penalties, and so forth, are provided for the different cases.—Lond. *Elec.*; April 10.

ELECTRO-PHYSICS AND MAGNETISM.

New Form of Radiation.—BLONDLOT.—A French Academy paper on experiments in which he discovered a new form of radiation by the action of which this radiation produced an electric spark. The rays are emitted by Röntgen ray tubes, but have properties different from those of other known types of radiation; while they are similar to infra-red rays by their invisibility and their general optical character, they penetrate aluminum, black paper and wood like Röntgen rays. They are polarized and refracted, but have no photographic action.—*Comptes Rendus*, March 23.

Emanation from Phosphorus.—SCHMIDT.—A paper in which he maintains that while air in which phosphorus evaporates, acquires electric conductivity, this is not due to an emanation of ions, but simply to the fact that the phosphorus fog contains a great number of oxidation products having a high conductivity. A charge is imparted to these particles by contact with one of the condenser plates, which provide the electric field.—*Ann. d. Phys.*, No. 4; abstracted in Lond. *Elec.*, April 10.

Theory of Magnetism.—ZACHARIAS.—An article in which he puts forward an ether theory of magnetism. He does not like the idea that a live solenoid produces a magnetizing force, parallel to its axis, which polarizes the particles of iron in its core; his view is that the current in the solenoid create a reduction of ether pressure in the core, and that magnetic force is entirely an electric pressure phenomenon. There is no such thing as magnetic attraction; an armature is forced against the poles of its magnet by the pressure of the ether on its particles.—*Verh. Verein f. Eisenbahnk, Berlin;* noticed in Lond. *Elec. Rev.*, April 10.

ELECTRO-CHEMISTRY AND BATTERIES.

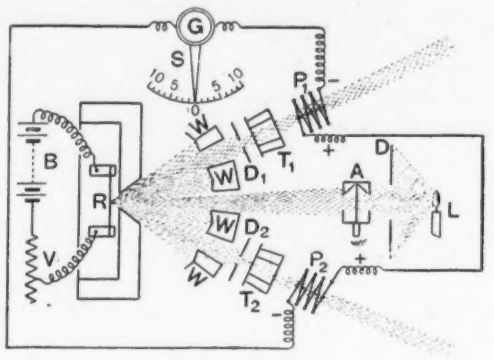
Electrolysis of Alkali Chloride Solutions.—FOERSTER AND MÜLLER.—A long account of a very extended experimental investigation. He sums up the theoretical results concerning the process at the anode as follows. In the electrolysis of aqueous solutions containing chlorine ions at the anode, two negative chlorine ions discharge to form a chlorine molecule. Besides this, there are formed at the anode hypochlorous acid and hypochlorite, either by a primary electrochemical reaction or by a secondary chemical reaction. For more alkaline or for more dilute chloride solutions, the formation of hypochlorites increases. Besides this electrochemical anodic process, there is also a formation of hypochlorite in the electrolyte itself by a reaction of the alkalies present there with the chlorine gas formed at the anode; but only that hypochlorite which when formed in this way is at some distance from the anode, has a chance to remain in the electrolyte. Chlorate is formed either by an electrochemical anodic process or by a chemical process in the electrolyte. The anodic electrochemical formation of chlorate is always accompanied by the development of oxygen gas. The anodic electrolytic generation of chlorate requires the presence of hypochlorite, which may either have been formed directly by electrochemical action at the anode, or may have been formed chemically in the inside of the electrolyte; in the latter case it takes some time before the hypochlorite reaches the anode and before the formation of chlorate is started. In strong alkaline or neutral and in very dilute acid chloride solutions, anodic development of oxygen may be due not only to the reaction just noticed, but also to the discharge of negative hydroxyl ions. The secondary chemical development of the chlorate in the interior of

the electrolyte takes place without development of oxygen. It occurs to a considerable degree, if in a large part of the electrolyte free hypochlorous acid can exist together with hypochlorite; i. e., if the chloride solution is slightly acid.—*Zeit. f. Electrochemie,* February 26 and March 5.

Aluminum.—J. B. C. KERSHAW.—A second article on the present position of the aluminum industry. He gives a few data on companies which have introduced aluminum as a substitute for copper for overhead electric conductors. In motor car construction work, the alloys of aluminum appear to have a promising future, and the manufacture of these alloys may become a flourishing sub-branch of the aluminum industry; "builders of automobiles will, however, have to recognize that aluminum and its alloys are not absolutely non-corrosive under all weather conditions; and they will be well advised if they cover all exposed surfaces with some protective varnish." The use of aluminum plates as a substitute for zinc, or in place of stone for lithographic work, is rapidly extending. For general foundry work, as an addition to iron and steel at the moment of casting, aluminum continues to be largely used. The Goldschmidt process for the productioin of high temperatures by the use of a mixiture of powdered aluminum and iron oxide appears to be widely used. Aluminum is also largely used for manufacturing ornamental articles, combs, etc., and is increasingly employed by opticians in the form of the aluminum-magnetism alloy "magnalium," which has a specific gravity of 2.52, is harder than pure aluminum and more suited for milling and screw-cutting purposes.—Lond. *Elec. Rev.,* April 10.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Standard of Light.—PETAVEL.—An illustrated article giving an account of a preliminary study for a new standard of light. There are three distinct types of standards; the first is the "absolute" one, the second a secondary standard carefully compared with the absolute one and preserved in a few of the principal laboratories throughout the world, and the third a commercial one, the accuracy of which will depend on the requirements; it will correspond, as the case may be, to the commercial scale. He claims that the problem of the first and third types of standards has been successfully solved. An absolute standard must be both constant and reproducible, and that *is* the case with the Violle standard. The commercial standards are very numerous and each has its distinctive qualities or defects: the "British candle" is the simplest and least accurate of them all; the "carcel" is free from flickering, unavoidable with an open flame, but is subject to considerable long period variations; the "Hefner" (or amyl acetate lamp) is convenient, portable and reasonably accurate, but very sensitive to atmospheric conditions, liable to flicker and gives too ruddy a light; the "Harcourt pentane standard," in its latest form, seems to combine the advantages of several of the previous lights. In his opinion several of these lights have considerable value as commercial standards. He then discusses the second type of standard and points out that "if we have a weight, a rule or a tape-measure, the accuracy of which we have reason to doubt, we do not go to the trouble and expense of sending them to the Bureau International des Poids et Messures; there are many laboratories in which a reasonably accurate comparison may be made." In the case of a standard of light the same facilities do not exist. The unit required for calibrating the commercial standard need not be reproducible, its one essential quantity is constancy. An electric lamp, the current through which is regulated by means of a potentiometer, will, during any one hour, show practically no variation, but in the course of days the light will steadily diminish. A Hefner lamp will vary slightly from minute to minute and from day to day; but, notwithstanding this, it will keep for years within a few per cent. of the mean value. For a satisfactory secondary standard both defects must be avoided and both qualities secured. Standards made incandescent by the passing of the electric current seem to promise the most satisfactory results, and the choice of the material seems to be limited almost exclusively to platinum, rhodium and iridium. The only satisfactory measurement of the temperature seems to be by the relative intensity of the radiation of two different wave lengths; for a metallic radiation as well as for a black body, the wave length at which the maximum radiation occurs is in inverse proportion to the absolute temperature; if, therefore, two wave lengths are selected, one in the infra red, the other in the visible spectrum, if in each case the energy of the radiation is measured in percentage of the total, it will be found that as the temperature rises, the former quantity decreases and the latter increases. At one given temperature only will the two quantities be equal. For analyzing the radiation it is best to make use of the thermal absorption of various bodies. Water and glass are practically opaque to radiation of a wave length longer than 3μ; on the other hand, black fluorspar is entirely opaque to the visible spectrum. If two thermopiles, one measuring the radiation through glass, the other through black fluorspar, are connected in opposition, there will be a critical temperature at which the resulting galvanometer deflection will be zero. The actual temperature at which this occurs will depend on the relative thicknesses of the plates and on the relative distances of the thermopiles, but for a given disposition of the apparatus it will always be the same. The adjoining diagram shows



STANDARD OF LIGHT.

the arrangement, B being a battery, V a variable resistance, R a radiating platinum strip in a water-cooled enclosure, G a galvanometer, W water-cooled diaphragms, T_1 and T_2 absorbing media, P_1 and P_2 thermopiles, A a photometer head, L a lamp, D D_1 and D_2 diaphragms. The author finally makes some critical remarks on Fleming's proposal of an incandescent lamp standard.—Lond. *Elec.,* April 10.

TELEGRAPHY, TELEPHONY AND SIGNALS.

REFERENCE.

Telegraphy and Telephony.—The first part of a summary of progress and improvements made in telegraphy and telephony during the last three months of 1902.—*Elek. Anz.,* March 1.

MISCELLANEOUS.

British Electrical Engineers in Italy.—The first part of an account of the present trip of the (Brit.) Institution of Elec. Eng. to Italy, 120 members are taking part in the visit. The journey was over Lucerne, the St. Gotthard Tunnel and Lugano, to Como. The first engineering visit was made to the Valtellini Railway, which as repeatedly noticed in the Digest, is an electric line with 3,000-volt, three-phase motors on the trains, the transmission being made at 20,000 volts to transformer sub-stations. There are four motors on each car, the cascade connection being used for speed regulations; all the switching gear is operated by compressed air; the system appears to be very satisfactory. It is stated that the visitors were especially interested in the lightning arresters on the extra high-pressure lines, consisting of three jets of water from earthed nozzles projected upwards into umbrella-shaped basins connected with the transmission line. These put a permanent earth on the line, but owing to the high resistance of the jets, which are ½ in. in diameter and about 10 in. long, only about 3 kw is lost in this way, while the protection against lightning is perfect.—Lond. *Elec. Rev.,* April 10.

Russia.—HEENAN.—An illustrated article on electrical developments in Russia. Recently electrical schools have been opened there, but there are only two factories turning out dynamos and lamps, and in consequence the importation is large, chiefly from Germany and Switzerland; next comes Great Britain and then follow the United States, France and Belgium. In St. Petersburg and Moscow the use of electric lighting is recent, but has increased enormously. The progress of the electrochemical and electrometallurgical industries is interwoven with the utilization of hydraulic power for current generation. There are several electrolytic copper refineries, a calcium carbide plant, and a large caustic soda plant; electric welding is in use in a number of works. Cables and storage batteries are made in some Russian factories, but no instruments whatever or

incandescent lamps. The only electrical industry fully supplied by home manufacturers is telegraphy. "It will require more than a casual visit to Russia on the part of business men if they are to win a proper share of the future business to be done in electrical appliances."—*Cassier's Mag.*, April.

REFERENCES.

Standardization.—An editorial stating that the British Government has granted $15,000 to the Engineering Standards Committee. This committee is supported by the (Brit.) Institutions of Civil, Electrical and Mechanical Engineers, the Naval Architects and the Iron and Steel Institute. It is pointed out that for electrical engineers, standardization of electric railway work would be most important, but that it will be necessary to proceed with great caution and deliberation in this part of the work.—Lond. *Elec.*, April 10.

Glass.—BOISTEL.—A long article on the mechanical and especially the electrical properties of glass as used in electrical engineering.—*L'Ind. Elec.*, March 25.

New Books.

REFERENCE LIBRARY OF MODERN ENGINEERING PRACTICE: STEAM, ELECTRICITY, MECHANICS. Illustrating and Explaining the Theory, Design, Construction and Operation of all kinds of Machinery. By Frank W. Gunsaulus, President Armour Institute of Technology, and 25 Collaborators. Chicago: American School of Correspondence at Armour Institute of Technology. Ten volumes. About 4,000 pages and 2,000 illustrations. Price, $40.

This is a work of considerable magnitude and not of a kind to be dismissed with a perfunctory review. We must state at the outset, however, that although it contains much matter that is admirable in quality, there are some features that we cannot even force into this category. To begin with, the mechanical makeup does not altogether fulfill the promise of the external appearance. The binding is in handsome red half morocco, which, unless it be considered too delicate for a book that is to be handled a great deal, is certainly all that could reasonably be asked. On opening a volume, however, we find that the paper is not of a quality that commends itself to our judgment. The typography is clear and legible, and on better paper would have been handsome. The cuts in many cases are good ones, but they do not stand the ordeal as well as the letter press and for the greater part do not show up as well as could be desired. In some cases they are decidedly poor, both in imprint and in design. The half-tones are mostly well chosen as to subject matter, and are apparently very good cuts, but the imprint on this paper is far from satisfactory. Indeed, it seems to us a triumph in press work that they are legible at all. The polychrome half-tones are printed on a different paper, better adapted to that kind of work, and are excellent examples of their kind.

The subject matter of this work embraces the greater part of electrical and steam engineering, so it cannot be expected that the articles will be exhaustive, particularly in the case of the less important ones. In an encyclopædic work there is a great opportunity for the exercise of editorial judgment in the allotment of space to different subjects; in fact this is one of the most important editorial functions. In the present work this appears to have been done in a satisfactory manner. Of course, there will always be some who will wish that more had been said about one subject even at the expense of other subjects, but on the whole the division of space will probably be satisfactory to the class of readers for whom the book was written. Take, for example, the article on metallurgy. It is obviously impossible that this article should be exhaustive, or even that it should discuss the metallurgy of all the commercial metals, so the greater part of the space is very properly devoted to iron and steel; the Bessemer and open-hearth processes, which are by far of the greatest engineering and commercial importance to-day, are described in a very creditable manner and the less important processes are more briefly treated.

The formulation of good definitions, next to the construction of sound theories, requires the highest grade of mental effort that the scientific writer is called upon to make. This book is weak in definitions. To be perfectly fair, we will state that most text-books are also; some writers who have international recognition as authorities cannot, or at all events do not, formulate good sound definitions. On the other hand, we have seen school books, such as arithmetics and elementary algebras, written half a century ago, in which the definitions were models of scientific accuracy. It surely is not hypercriticism to apply the principle that a definition that will not bear analysis is useless. The opening statement of Volume VII, under the heading, "Elements of Electricity," is as follows: "Electricity is an invisible agent which manifests itself in various ways. The precise nature of electricity is not known, but the effects produced by it, the methods of controlling it, and the laws governing its action are becoming well known." It has been for many years with many persons a favorite catch phrase, that we do not know what electricity is, or that we do not know the exact nature of electricity. Granted, but in the same sense that we do not know what electricity is, we do not know what anything else is. For example, what do we know about the ultimate nature of matter? More than two thousand years ago some of the Greek philosophers assumed the existence of atoms, and the atomic hypothesis in one form or other has continued to the present time. With the ancients the atom was what its name signifies, indivisible. With Boscovich it was not only invisible in fact, but also in concept—a mere center of force, a mathematical point. Then Lord Kelvin made the atom a minute vortex in a frictionless fluid, and now J. J. Thomson tells us that the smallest atom is not only divisible, but actually is divided, being composed of a large number of still smaller bodies. No one of these hypotheses is more than an hypothesis, or rests on direct experimental evidence of a convincing character. We then know as much of the ultimate nature of electricity as of matter, and matter is certainly at the head of the category of familiar things. Take next the attraction of gravitation. A little investigation will show a similar state of knowledge in this case also. A number of conflicting speculations, but nothing proved. In this clause of the definition, therefore, there is nothing characteristic of electricity, and so far the definition is useless.

The next clause of the definition states that the effects, etc., are becoming well known. Maxwell, in the preface to his treatise written thirty years ago, says: "The internal relations of the different branches of the science which we have to study are more numerous and complex than those of any other science hitherto developed." "The mathematical laws of the different classes of phenomena have been to a great extent satisfactorily made out." This is certainly all that could have been said of any science at the time. It is, of course, true that we are learning a great deal about electricity, just as we are about other sciences, but the implication that we are only just beginning to learn is entirely wrong. Students of Maxwell find many of the alleged new discoveries recorded in that remarkable work. The second sentence of the definition quoted is, therefore, reduced to a mere platitude. The first sentence, stating "Electricity is an invisible agent," although perhaps unassailable as a statement, conveys very little information.

The second paragraph begins: "Electricity may be considered under three heads: First, magnetism; second, static electricity; third, dynamic electricity." This has a delightful Hibernian flavor. We have heard that a mule makes a very good horse when you don't try to yoke him up with another ox.

Under "Magnetism" we read: "Substances which have the property of attracting pieces of iron are called magnets." This is simply a case of faulty diction. It should read "bodies," instead of "substances." A substance may be magnetic, but it is not a magnet. A definite portion of a substance, that is a body, may be a magnet.

Turning to the section on "Electrical Measurements," we read, "Fundamental Units. All physical quantities, such as volume, velocity, force, etc., are derived from, and can be expressed in terms of, the three fundamental quantities—length, mass and time." This definition contains several misstatements, although the writer of the definition may perhaps stand ready to defend it on the ground that he got it from some other book or books. At all events the errors are very widely circulated, and it is, therefore, all the more urgent that when a new book is published it should not repeat them. The units of all other physical quantities may be, and are, expressed or defined in terms of the three fundamental units, length, mass and time, but it is absurd to speak of one quantity being derived from another. Cubic feet cannot be manufactured out of linear feet by any possible jugglery. A linear foot is no more fundamental, except as a matter of convention, than a square or cubic foot. A cubic foot does not exist because a linear foot does, but linear, square and cubic feet exist because space, or extension, has three dimensions. If there were anything in the idea that length is fundamental

and that area and volume are derived therefrom, then we could derive figures of four or more dimensions, and pan-geometry would be realized. The whole theory of derived units rests on this principle. We assume a unit length, and then take for unit volume a cube whose length, breadth and height are each one linear unit. We do not derive the volume; that is just as fundamental as the length. Neither is any other quantity "derived" at all, or any unit derived except in the sense just explained.

The next error is excusable, on the ground that Maxwell says on the first page of his first volume, "It is possible to define these units in terms of the three fundamental units of length, time and mass." This is interpreted by many to mean that there cannot be less than three fundamental units, but this is misinterpretation, for on the fourth page Maxwell states that in the astronomical system the unit mass is defined in terms of the units of length and time. Moreover, in the metric system the unit of mass is really a derived unit, although this fact is usually ignored. It is the mass of unit volume of water at a standard temperature. Both these systems reduce the fundamental units to two, and as a matter of theoretical interest, they may be reduced to one.

The book goes on to say: "Each of these quantities is independent of the other, and can only be measured in terms of its own units." We have just seen that all physical quantities are independent, and that they can only be measured in terms of their own units, is obvious; else why do we have a different unit for each quantity? Why, for example, do we not measure e.m.f. in centimeters or inches? On the other hand, the units of length, time and mass may be defined in terms of other units. These units happen to be most convenient to base a system upon; that is all.

It is hard enough to teach the theory of units so that it is really understood in any case, as is evident from the number of persons, including college professors and writers who have read Maxwell without understanding him; but from definitions like the foregoing the truth cannot be extracted—it can only be learned in spite of them. For example, toward the bottom of the same page we read, "the area of a rectangular surface is obtained by multiplying the length by the width. . . . It is, therefore, evident that the only unit entering into the measurement of surface is *length*, and that the surface is measured by the product of two lengths." This is positively vicious. As well say that the only unit entering into the measurement of temperature is length, because in an ordinary thermometer the temperature is indicated by a scale reading. The product of the *number* of linear units in the length, by the *number* of linear units in the width, equals the *number* of superficial units in the area of a rectangle. It is only in this sense that two lengths can be multiplied at all. One at least of the two factors of a product must be an abstract number. The product of a length by an abstract number is a length, the product of two lengths is impossible and the product of two abstract numbers is an abstract number. The only unit entering into the measurement of surface is the unit area. But enough of this.

The book is on the whole better in its treatment of practical subjects than in its exposition of theory. The articles on pattern making, foundry practice and subjects of similar nature are good. We note a method, in the article on mechanical drawing, of dividing a right angle into six angles by means of the two ordinary draughtsman's triangles. The reviewer worked out this method himself in his callow days, but has never before seen it in print, and it seemed like meeting an old friend to encounter it here.

Einfuhrung in die Elektrochemie. Nach der Elektrolytischen Dissociations-therie. By F. Gertes. Halle: Wilhelm Knapp 124 pages, 48 illustrations. Price, 4 marks.

This little volume is intended to be an introduction to electrochemistry, written with the purpose of serving as a primer, so to speak, for people who have no acquaintance with, and no particular training for, the subject. It is, therefore, written in a popular style, and the author devotes considerable space to the discussion of electric, magnetic and chemical principles. The treatment of the electrochemical subjects is based altogether on the dissociation theory, because, in the opinion of the author, this theory has already caused a great revolution in the field of electrochemistry, and quite certainly will continue its influence into the future. Practical applications of electrochemistry which one might expect to see discussed in a work of this kind are only touched upon in the most superficial manner in five pages, more than three of which are devoted to electroplating.

It is a very difficult matter to write in a popular manner on scientific subjects, and requires an intimate knowledge and thorough mastery of the subject. How it can be done successfully has been shown by men like Faraday, Helmholtz and others prominent in the field of science. The author of the present volume falls far short of the standard set by these men. He has failed to reach an intimate knowledge of the subject and therefore the book abounds in inexact definitions and inaccurate statements. For example, on page 38 it is said: "There are a few chemical elements, the atomic complexes (molecules) of which consist only of one atom, and hydrogen (?) belongs to them." Again, on page 72: "If we bring silver (Ag) into nitric acid (HNO_3), one atom of silver combines with the nitrogen (?) of the latter, whereby the hydrogen is set free and escapes." On page 73 we find the following statements: "Potassium (K) and sodium (Na) are strong bases" (?). "If one replaces the hydroxyl in the base NaOH (caustic soda) by an acid residue, as SO_4, there is formed the compound $NaSO_4$ (?), sodium sulphate or Glauber's salt." Instances like these might be multiplied. The writing of text-books in such a manner cannot be too strongly deprecated, especially when they are intended, as in the present instance, for the use of beginners.

Elektromechanische Konstruktionen. By Gisbert Kapp. Berlin: Julius Springer. 292 pages, 114 illustrations. Price, 20 marks.

In this second edition of Kapp's very able and useful book, the author has made a number of important additions of considerable extent, thereby bringing the book up to date. Of the 25 large folder plates, seven showing the older constructions have been replaced by 18 showing the more modern machines, thus increasing the scope about 40 per cent. It therefore almost deserves to be called a new book rather than a revised edition. The same is true of the collection of formulas.

The general nature of this large quarto volume, with its inserted volume of plates, is a very well selected and arranged set of formulas and data involved in the calculation, design and construction of electric machinery, including continuous and alternating-current dynamos and motors of various typical kinds, such as railway generators and motors, single and polyphase generators and motors, transformers, regulating switches for accumulator installations, etc. Rotary converters are absent, probably because this apparatus is now out of favor abroad, though developed there. Numerous very large folded plates of working drawings are given of actual machines, as made abroad. These are exclusively of European manufacture, and most of them were constructed in Germany, the types of machines made in the United States being represented only by a few built by the European representatives of the American companies.

The text accompanying these drawings gives the method of calculating them, the reasons why certain arrangements or constants were preferred, and similar information, together with curves of data. The deductions of the formulas is not given, as the author distinctly disclaims the book to be a treatise on this subject, on the contrary being limited to a collection of examples of design and construction taken from actual practice, and as such it is a very excellent one.

Special stress is laid on the importance of using formulas intelligently, and with discretion, and not merely mechanically, as may be done with mathematically exact formulas. Many of the formulas involved are correct only when correctly applied, and the author very properly emphasizes this. He has even illustrated it by showing cases in which a particular formula is not correct, and he gives the reasons for this.

The discussion of the respective machines is in some cases very extended. For instance, in connection with street railway motors he discusses also the time schedule or diagram in the operation of cars.

From a publisher's standpoint, the book is conveniently arranged. The folded plates are bound separately in paper, being inserted in a sort of pocket under the same cover as the text. The advantage of being able to use them apart from the book is evident. The illustrations are clear and well prepared. The text is very wisely printed in the same type as is used by other nations, and not in the very objectionable native German type. The margins are exceptionally wide, forming considerably more than half the page, which is very convenient for notes and additional data.

The book is unique of its kind, and can be very highly recommended to all constructing engineers and students. The high reputation of its author is a sufficient guarantee of the reliability and choice of the matter contained therein. It is to be regretted, of course, that American machines are not included, but for this the blame presumably rests with the American manufacturer, whose principle in keeping the design of machines a trade secret, or at least trying to do so, is very wisely not shared by the foreigners, who feel that a free discussion and exchange of views is of great advantage so far as the art is concerned, while at the same time keeping manufacturers from getting into ruts and perhaps staying there, sometimes without knowing it, until the less secretive foreigner calls attention to his plight.

A similar book on American machinery by an equally able authority, might be more acceptable to American readers, but in the absence of such a book, and in view of the fact that probably none equal to it will ever be published here, under present conditions, the present one is unquestionably the best that exists. It may safely be said that every designer of such machinery will find it of great value.

Directory of Electrical Societies, Etc.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, C. J. Reed, 929 Chestnut Street, Philadelphia, Pa.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, Ralph W. Pope, 95 Liberty Street, New York.

AMERICAN ORDER OF STEAM ENGINEERS. Secretary, Frank C. Rose, 10 Federal Street, Pittsburg, Pa. Seventeenth annual convention of the Supreme Council of the United States, Pittsburg, May 11.

AMERICAN STREET RAILWAY ASSOCIATION. Secretary, T. C. Penington, 2020 State Street, Chicago. Next meeting, Saratoga Springs, N. Y., September 2, 3 and 4, 1903.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, W. H. Johnson, Philadelphia, Pa.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Secretary, P. W. Drew, Colby and Abbott Building, Milwaukee, Wis. Next meeting, New Orleans, La., May 13, 14 and 15, 1903.

CANADIAN ELECTRICAL ASSOCIATION. Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Toronto, Ont., 1903.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, Wm. J. Davis, Ithaca, N. Y.

THE ELECTRICAL TRADES SOCIETY (Member National Electrical Trades Association). Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets every second Friday of each month.

ENGINE BUILDERS' ASSOCIATION. F. P. Ide, Springfield, Ill., Secretary.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Secretary, James B. Cahoon, 136 Liberty Street, New York. Next meeting, Chicago, May 26, 27 and 28, 1903.

The Latest Big New York Hotel.

The magnificent Hotel Astor, which is now under construction at Forty-fourth, Forty-fifth Streets and Seventh Avenue, New York—the new "center of the town," socially speaking, is to be equipped with one of the largest and most elaborate electrical plants for hotel use in this city. The contract for the electrical equipment has been awarded to the Western Electric Company.

The generators, which will run on superheated steam, will be four in number, each having a capacity of 250 kw. They will be direct-connected to tandem-compound engines of 400 hp each. The engines will be built by the Providence Engineering Company. The boilers—1,600 hp in four units of 400 hp each—will be of Babcock & Wilcox build. Forced draft will be used so as to permit of the boiler capacity reaching 2,300 hp.

Thirty-nine motors, varying from 3 hp to 20 hp, and aggregating in all 250 hp, will be utilized for operating the ventilating system, conveyors, elevators, pumps, laundry machinery, etc. The B. F. Sturtevant Company, Baker, Smith & Co., and Howard & Morse will instal the ventilating system. The Otis Elevator Company will build the elevators, nine of which will be installed. The pumps are to be of Worthington (Dean) and Goulds type. The Stair Lift Company, of Nicetown, Pa., is to build the electrically-operated conveyors. Each of the 500 odd rooms in the hotel will have a telephone and fire alarm. There will be 17,000 lights in the building, and a variety of other electrical facilities, novelties and "contraptions."

Heating and Ventilation of Railway and Other Shops.

At a recent meeting of the New York Railway Club discussion took place upon the subject of heating railway shops and other one-story buildings of the same nature. While such buildings are very simple in construction, they are not so simple as might appear in regard to the problem of effectively and efficiently distributing heat and air. On account of the large amount of roof, wall and window surface, the loss of heat is very great, and also, because of this and the relatively great height of the building considered as a single room, there is a tendency towards unequal distribution of the heat, the warm air rising to the roof and the cold air flowing to the floor, where it renders the workmen uncomfortable. It is important, then, not only that a sufficient quantity of heat should be delivered to the building, but also that it should be delivered where it will do the most good.

In the discussion, Mr. C. H. Gifford, of the B. F. Sturtevant Company, advocated the adoption of the fan system as one rendering the control of the heating apparatus and of the ventilation ideal. During very cold weather, or in the morning when the building is being heated up, the air supply may be drawn from within the building itself, thus effecting a great economy of heat. In some buildings having a very high cubic space per occupant, sufficient ventilation during the winter time will be supplied by the leakage of air through doors and crevices about the windows, by transfusion, etc.

The following general classification of railway shops was given: First, machine, erecting and car shops. Second, paint shops. Third, round houses.

The second and third require special treatment. Paint shops require to be practically dustless and, consequently, the air velocities must be low. The temperature requires to be higher, and it is customary to arrange to circulate the air in a much more thorough manner than in shops of the first class.

This is done in the Pennsylvania Railroad shops at Altoona by means of ducts and in the New Haven shops, Readville, by a similar overhead system. There has been a great deal of hesitation among railroad men about installing the hot-blast apparatus in paint shops. They are afraid of getting their varnish dusty. But I might name a dozen or so paint shops all over the country; for instance, the Boston & Albany shops, at Allston; the New Haven shops, at Readville, and there are several Western shops, all of which are heated with the hot-blast system by a very ample distribution of air. The circulation is brought about by a counter-exhaust system, which circulates the air, returning the whole or a part to the apparatus. There are two ways of establishing this return of the air; one by an underground duct system, and the other by an overhead galvanized system. In the Pennsylvania Railroad shops, at Altoona, we have an installation that has been in a dozen years. I think it is one of the first we put in that returned the air from underground and back to the fans, using very ample distribution of air-pipe in the discharge.

In the Readville shops the air is brought back by means of an overhead galvanized pipe. In this way circulation is kept up in all parts of the room and thereby the paint is dried much more rapidly than it would be by any other system where the air in the room is practically still.

Round houses have been much neglected up to recent years, but of late they have been receiving better attention. Their proper heating is a problem of no little moment.

The hot-blast system of heating is a great improvement over the old method, since it allows for ventilation in the winter time with both windows and doors closed. In this class of buildings the air should be delivered through ducts which terminate in the walls of the pit, thus delivering the air where it will be most effective for thawing out engines that have come into the house covered with snow and ice. At the same time it is a very good idea to have a provision for admitting some of the air above the floor in case there are no locomotives which need special attention.

Automobile Charging Outfits.

To meet any case that may arrive in automobile charging service, the Westinghouse Electric & Manufacturing Company has devised a system admitting of no less than 168 combinations and variations—a sufficient variety undoubtedly to meet any conditions or demands of either private or public charging stations. With these combinations, one, two, four, twelve or more automobiles can be charged at once.

The outfits for charging one or two machines are intended for private use, that with a capacity of four are suitable for clubs, country houses, or small stables, while the standard twelve service is applicable for use by public garages, express and cab companies, or other establishments having a number of vehicles.

One of the chief advantages of the garage installation shown in Fig. 1—the only one possessing this valuable feature—is that all controls are at one point, with minimum apparatus, instead of, as in the former practice, having them individualized and spread over considerable space, involving double the trouble and expense. There is also a saving in that instead of being compelled to use twelve voltmeters and twelve ammeters, one of each is sufficient.

Another important item is that the charging may be in serial or simultaneous. Fig. 2 shows one of these garage switchboards with the series rheostats installed below it for controlling the charging rates of the various batteries. In this particular case rheostats are provided for eight vehicles, the greater capacity being obtained at any time by adding the requisite number of rheostats.

Each switch on the board is numbered to correspond with the number of its rheostat and charging stand. The throwing of a switch to the left places a battery in "charge"; reversing to the right connects the ammeter so that the current may be read. The voltmeter will indicate for the whole main line, or by pressing the push button corresponding to any switch the voltage reading of its

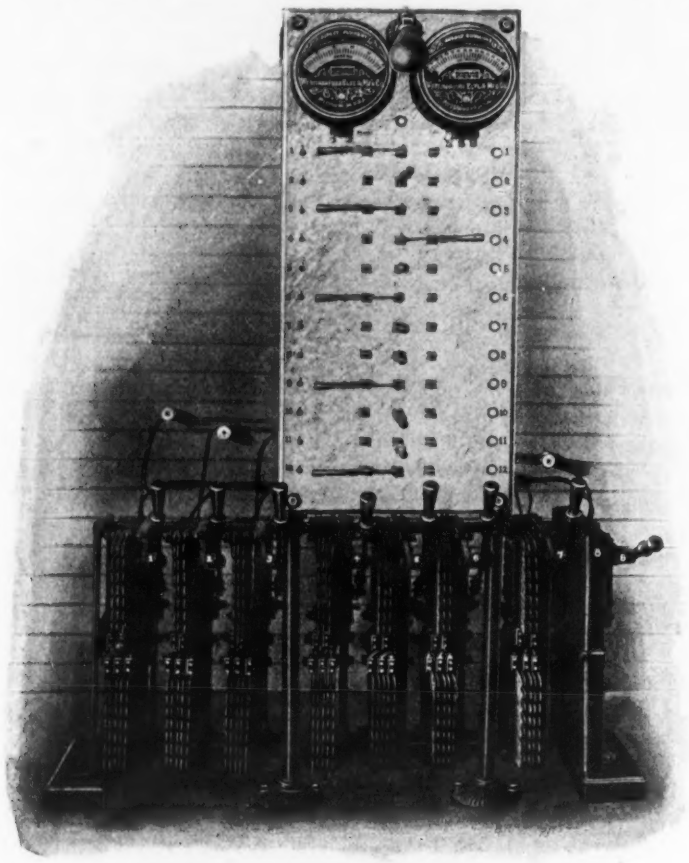


FIG. 1.—GARAGE INSTALLATION.

stand can be taken. A separate push button gives the voltage reading on the line beyond the rheostats. Opposite each switch is a numbered hook upon which the charging record of the battery may be kept.

In connection with this central switchboard automatic circuit-breakers and fuse blocks are to be used at each charging stand. These switchboards (Fig. 2) may be connected with any 125-volt, direct-current line, whether from central stations, motor-generator set, or independent circuit.

For the one or two vehicles of the private owner, or the small garage designed for four machines the panels are as shown, with the necessary modifications in each case, and are adapted for direct-current voltage of 110 to 125. For single charging the automatic circuit-breaker is mounted directly upon the panel with the meters and fused switch. Where two or more automobiles are to be charged the circuit-breakers are displaced by switches, and the over-voltage circuit-breaker and fuse blocks are located at the carriage charging stands.

The meters, which for private use may be a combined voltmeter and ammeter, are provided with sub-scales and convenient terminals for reading voltages of individual cells; with volt scale from

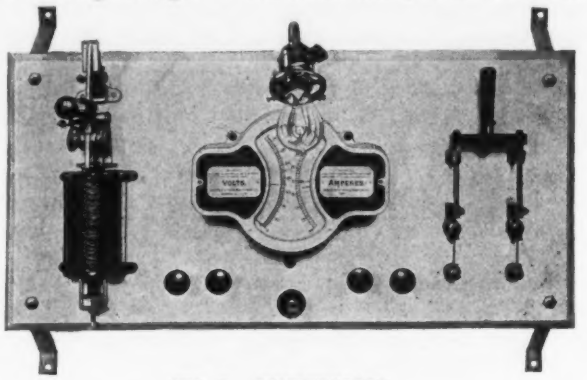


FIG. 2.—SWITCHBOARD.

0 to 150, sub-scales 0 to 3, and ampere scales 0 to 100. The circuit-breakers under normal circumstances automatically cut out the battery when the charge is completed, and in all cases protect the battery from any over-charge danger or damage, enabling the owner or attendant to set the charge and pay no more attention to it until the machine is again wanted for use, without loss or damage of any kind. The motor-starter rheostats, employed in starting the direct-current motors are mounted on the back of the panels, with handle projecting through; the same as with the generator field rheostats. Where a generator is employed the latter are used for the regulation of the battery charging of one carriage, without requiring the additional series rheostats of the grid or imbedded type. Where the series rheostats are needed, they are made in one of three types—grid, embedded or combined. In the first form they are mounted on the floor directly below the switchboard, the grids being of cast iron, set in the open air, thoroughly ventilated, and while they are normally made to carry 60 amp. each, they can be immensely overloaded without injury, surviving unhurt where other types burn out. This is an important point, since it obviates all danger of battery injury by the burning out of the rheostats, a danger that has been, and in some types still is, found only too frequently. The imbedded type of rheostat is in two styles, designed for use with either 10 to 14 or 20 to 24 cells, when charged from a 125-volt line, will each carry continuously 30 amp., and may be mounted with several of the same type or with the grid type. The life of the battery itself practically has no limit. Its efficient existence is merely a question of renewing the plates at long intervals when they are worn out.

The direct or alternating-current motor-generators furnished by the Westinghouse Company are of standard type and adapted to the panel used, transforming high-voltage, direct-current to the proper voltage, or changing alternating current to the desired voltage, direct current for charging. These present an advantage in that, being standard, they are always a marketable commodity.

In cases where the owner prefers his own isolated plant of gas or other power for driving a generator, accessory apparatus to meet the requirements has been added to the outfits.

Connecticut Purchase Law.

A report directing that the city shall pay $500,000 for the plant of the Norwich (Conn.) Gas & Electric Company, has been filed by a commission which has been investigating the matter. The proceedings were brought under the State law regarding the purchase of the plants of existing lighting companies by cities desiring to enter into the business of municipal lighting. This is the first report filed under the new law.

Queen's Engineering Works, Bedford, England.

One of the British engineering firms most widely known is the W. H. Allen, Son & Co., Limited, formerly having its works at Lambeth, London, and since 1894 at Bedford, where the Queen's Engineering Works were established in 1894. The illustration of one of the fronts of the works given herewith illustrates the admirable European practice of not neglecting architectural effect in the construction of buildings intended for manufacturing purposes.

The works have been built and specially equipped with plant, arranged for the manufacture of the highest class of machinery comprising auxiliary machinery for the Admiralty, dynamo-electric machinery, centrifugal pumping engines, air pumping machinery, fan engines and small electric gear for the mercantile marine and machinery for large central stations, comprising engines and dynamos, motors, condensing plants and air pumps. The electrical machinery of the Queen's Works enjoys an enviable standing throughout Great Britain and the colonies.

The works employ about 800 men. Very complete American methods have been adopted for the manufacture and interchangeability of parts, and some of the latest American machine tools have been put in during the last few years. The company has for several years past taken a great interest in the training of pupils, Mr. W. H. Allen devoting his personal attention to their progress. Messrs. Allen have set aside a department for this purpose and a demonstrator is in constant attendance who not only assists in solving difficult problems connected with their work, but also guides them as to the literature of allied subjects so that they may be able to read in their spare time and attain a deeper knowledge of their work.

FACADE OF QUEEN'S ENGINEERING WORKS.

The demonstrator superintends each pupil in the various departments and is entirely responsible for the work they are engaged upon. Lectures are given in a spacious lecture room connected with the main offices every Monday evening on various subjects. The pupils are also in constant touch with the directors, who endeavor to exercise a useful control in the welfare of each pupil generally. The pleasant relationship existing between the company and its employees is one of the characteristics of this admirably organized establishment, the result being a spirit throughout the works that everyone shall do the best he can for the company.

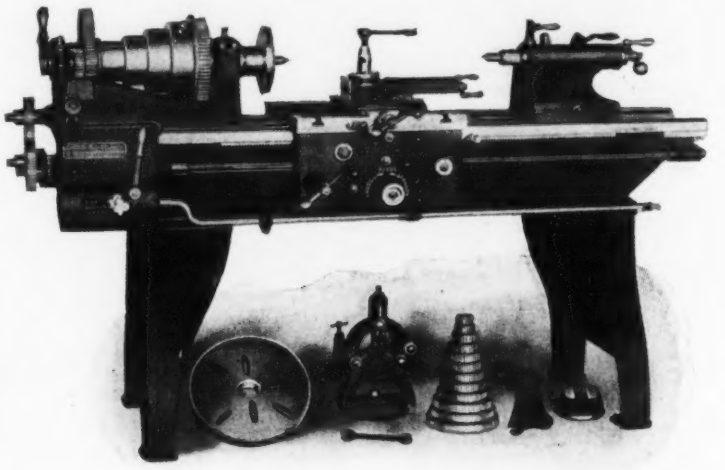
Chloride Accumulators.

The Electric Storage Battery Company, of Philadelphia, manufacturer of the "Chloride" accumulator, has recently closed contracts for a number of installations for isolated plants. Among these may be mentioned a large battery for the Astor Hotel, New York City, an installation for the Edmore lighting station, Edmore, Mich., and residential battery plants for Reginald Vanderbilt, Portsmouth, R. I.; Thomas Morrison, Pittsburg, Pa.; B. F. Jones, Sewickley, Pa.; J. J. Ryker, Port Chester, N. Y., and the Peace Dale Manufacturing Company, at Peace Dale, R. I. The last-named installation is made for the purpose of lighting six residences, a library, a church and two office buildings. The company has, however, a continuous growing demand for its batteries in a variety of miscellaneous work, outside central stations and isolated plants.

New "Star" Screw-Cutting Engine Lathe.

We show in the accompanying cut a new size (14-in. swing) of the "Star" lathes, which has been designed to meet the demands of modern shop practice, for using high-speed tool steel, large feeds, big cuts, etc. This lathe has an actual swing of 15¼ in. over bed, 8⅞ in. over plain and compound rests and 6¼ in. over rise and fall rests, with 6-ft. bed, a distance between centers of 34 in., and the net weight of 1,625 pounds. The head stock is heavy, it has a hollow spindle with 1 3-16-in. hole, made from a crucible steel forging, and large bearings of phosphor bronze. The spindle is ground true and the bearings are hand-scraped to insure an accurate fit. The cone pulley has four extra wide steps for a 2¼-in. belt; the ratio of back gearing is 9 to 1. The tail stock is the curved pattern, which allows the compound rest to swing around parallel with the ways and over the base of the tail stock, with room to operate the feed screw handle. The tail spindle has improved locking device, which insures perfect alignment. The tail stock has long bearing on the bed and is locked to the bed in such a manner as to render it very rigid.

The carriage is extra heavy, and provided with "T" slots for bolting on angle plates, etc. It has long bearing on the ways and is gibbed to the bed. A new cam-locking device in the apron is provided for locking the carriage to the bed when using the cross feed. This device is operated by the same lever that operates the split nut on the lead screw and the split nut cannot be engaged with the lead



SCREW-CUTTING LATHE.

screw when the carriage is locked to the bed. The cross feed screw is graduated to read in thousandths of an inch. The compound rest has extra long travel, 5¼ in., and is capable of fine adjustment as the base is graduated. The tool post has a patented collar and shoe, which exclude all dirt and chips and admit of quick, easy and secure adjustment of the tool.

Power is transmitted from the head spindle to the lead screw entirely by gears and is arranged with three changes of feeds—fine, medium and coarse. There is a new friction feed, by which both cross and longitudinal feeds are thrown in and out of contact by one hand knob on the apron, which operates a double friction clutch in connection with a worm gear, which is actuated by a phosphor bronze worm on the lead screw. This construction prevents both cross and longitudinal friction feeds from being thrown in contact at the same time. The worm is keyed to the lead screw, which is spliced and simply acts as a feed rod, therefore the only wear on the threads of the lead screw is in screw-cutting. The range of feeds is very large.

The range of screw-cutting is extra large, cutting all standard threads without compounding the change gears and nearly all threads by compounding. The bed is extremely broad, deep and heavy and all other parts are accurately proportioned throughout, making a very strong, stiff and rigid lathe. The countershaft has patent friction clutch pulleys, easy to operate, strong and durable, also has adjustable and self-oiling shaft bearings.

This lathe, which includes also a number of other desirable features, is made by the Seneca Falls Manufacturing Company, Seneca Falls, N. Y.

An English Photometer.

The instrument illustrated herewith is designed for comparing two lights of the same or different colors and thus facilitating the estimation of the intensity of one in terms of the other. The researches of Rood, Ferry and Whitman, from 1892 to 1896, on the subject of retinal sensitiveness to varying luminosities, more especially in respect to the retentiveness or duration of the impression of luminosities of different tints, prove conclusively that intensity is the sole arbiter of the length of such impressions, and that color

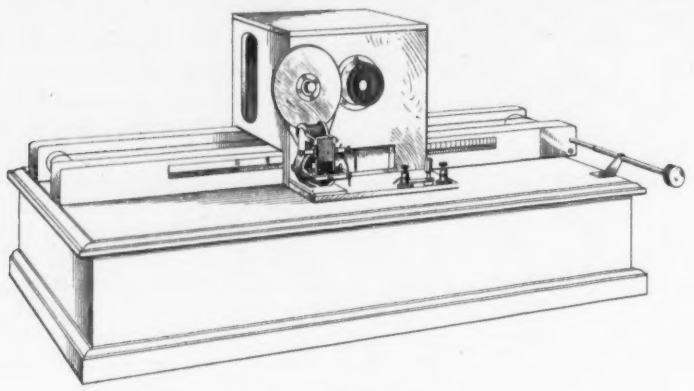


FIG. 1.—PHOTOMETER.

has no influence in the matter, and this conclusion has been confirmed by recent experiments of Simmance and Abady. This being granted, it is obvious that a photometer which, taking advantage of this phenomenon, bars out all differences of color and only registers intensities, will abolish the uncertainties which have accompanied tests of various tints of light.

It is found that if rays from two sources of light, one being, for example, red, the other green, are allowed to fall in rapid succession upon a screen or upon the retina, the eye ceases to distinguish the colors, and is only sensible to the degree of intensity of the illumination. The utilization of this fact in a photometer satisfies practical conditions, for if the intensities of the two lights red and green are equal, no difference in the illumination is perceptible (the eye losing all sense of the colors), whereas if the intensities differ, the eye is acutely sensible of the fact.

The Simmance-Abady photometer as illustrated is claimed to be a simple means of carrying into practice the above theory. Beams from each light (one being of a known power and the other unknown) are directed on a paper screen across which vibrates a shutter, cutting off each ray in turn. Thus the eye perceives only one ray, the source of which is each light alternately. By careful adjustment the duration of each ray is exactly the same, and the two rays do not overlap. If the lights are unequal in power the oscillation of the shutter at a given speed produces a vibrating effect,

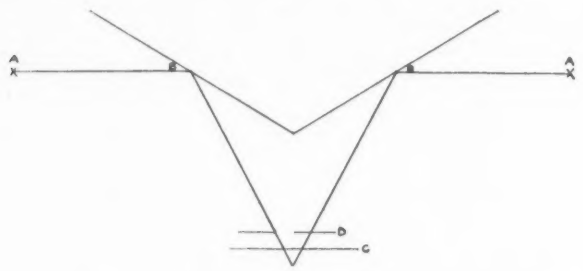


FIG. 2.—DIAGRAM ILLUSTRATING PRINCIPLE OF PHOTOMETER.

but by moving the screen and shutter nearer the weaker light, a balance is gradually set up until the distances are such that rays from the two sources are equal, which point is indicated on the screen by a total absence of the vibration. Under these conditions the shutter cuts off first one ray and then the other without the eye being sensible of any movement; for although the rays may be of different colors yet the retina ceases to discern color and only judges intensity. In Fig. 2 *A A* are the lights, *B B* the reflecting surfaces, *C* is the illumination screen, and *D* the vibrating shutter.

The introduction of this practical form of photometer, based on long known laws, has enabled very accurate estimations to be made of the actual power of electric arc lamps and the incandescent gas (Auer) light. A proof of the delicacy of the readings is afforded by the fact that when lights of the same color are tested by it, the results agree exactly with those made with the Bunsen or Lummer-Brodhun apparatus; whilst when the lights vary in color, different operators disagree totally in their readings with these photometers, but it is stated that all experimentalists coincide to the smallest fraction when the same lights are tried with the Simmance-Abady instrument.

The instrument is provided with means of reversing the light-receiving surfaces so as to avoid error through inequalities of material, and every angle and measurement is convenient for verification. The manufacturers are Alexander Wright & Company, Limited, of Westminster, England.

Fan Motor and Battery.

Messrs. J. Jones & Son, 64 Cortlandt Street, New York, are placing on the market a fan motor and battery, which we illustrate herewith. The motor in its general features follows closely the lines of motors made to run on lighting circuits. The body stands on a

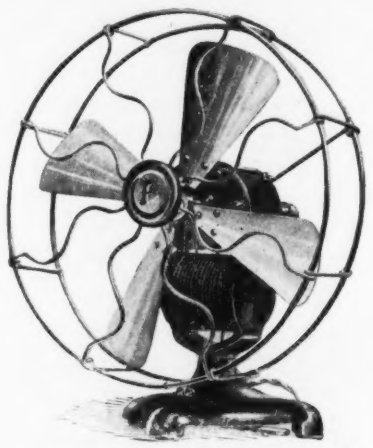


FIG. 1.—BATTERY FAN MOTOR.

base containing the switch, the handle of which protrudes in the ordinary manner. The fields are properly proportioned for work on low current and in connection with the armature are designed for high efficiency. The fan blades are well balanced, a thing greatly needed in a battery fan where every little item means a call on the battery. The guard is a heavy one, well made and strong, with which the motor can be handled without trouble; it is made for

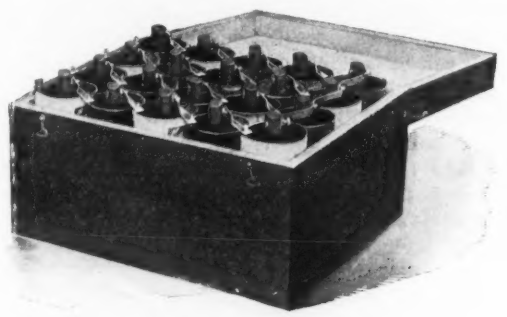


FIG. 2.—BATTERY OF DRY CELLS.

handling, in fact, and is not the usual flimsy affair. The shaft, like the other parts, is mechanically balanced to a nicety in its bearings, and lubricated by means of efficient oil cups. In short, the fan is made mechanically and electrically for the work required of it—made with the view of having the battery power operate on the motor, and not expend its energies uselessly.

The battery consists of dry cells, and thus is free of the disagreeable features of recharging elements, odors and acids to leak and spoil the carpets, and may be placed among the most delicate furnishings in any position, and is guaranteed to run with ordinary use for at least 250 hours, and, therefore, during an entire season.

The Robb-Mumford Boiler.

The Robb-Mumford, internally fired boiler, illustrated herewith, although new to the American market, has been manufactured extensively for several years in British America, where it has been used for almost all purposes in various parts of the country from the Atlantic to the Pacific, with good and bad water and a variety of fuels, the conditions being similar to those in the United States. The result is that the boiler has passed through a process of evolution, in which the weak points have been eliminated and many improvements made.

The boiler consists of two cylindrical shells, the lower one containing a cylindrical furnace and tubes, and the upper forming a steam and water drum, the two being connected by two necks or circulating pipes. The lower shell has an incline of about one inch to the foot from the horizontal, for the purpose of promoting circulation and draught. A steel casing, stiffened by angle irons and lined with asbestos air cell blocks, forms the rear smoke box and return smoke flue between the lower and upper shells, the upper half of the steam drum and bottom of the lower shell being also covered by non-conducting material.

The furnace is of the well-known "Fox" or "Morrison" corrugated type, without joints, providing for expansion and contraction, and requiring no staying. The heads of the steam drum are spherical, and the tube sheets are stayed by the tubes; as every part of the boiler is cylindrical except the tube sheets, no other staying is required.

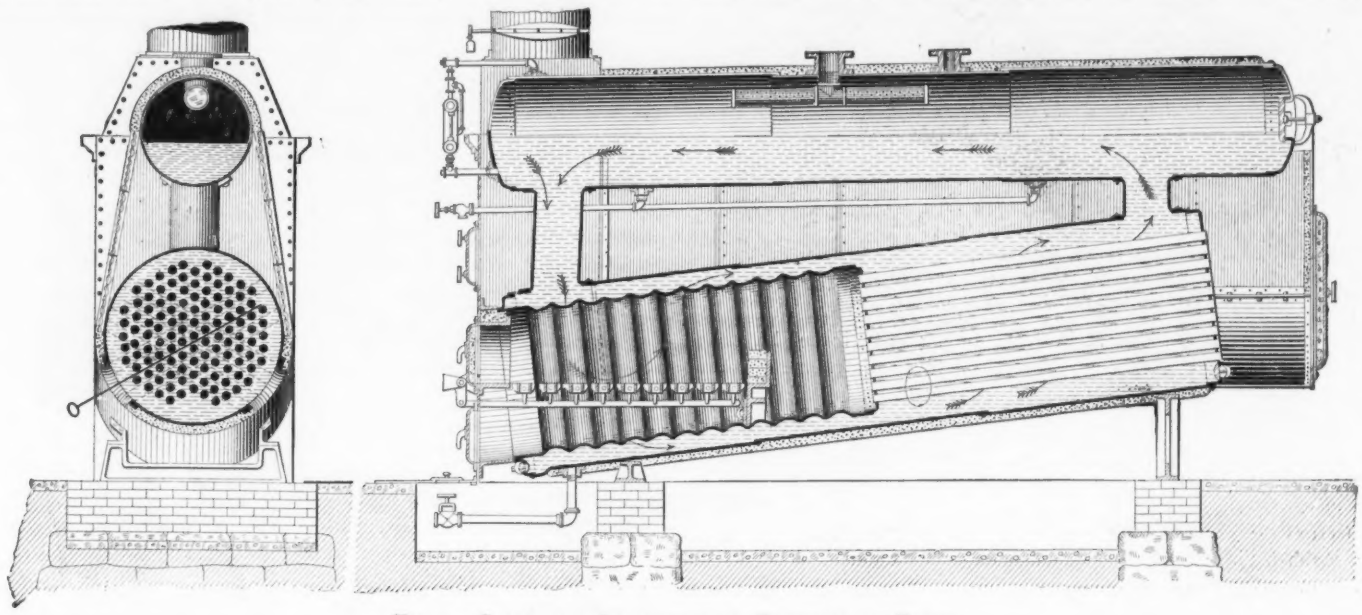


FIG 1.—CROSS AND LONGITUDINAL SECTIONS OF BOILER.

The gases, after leaving the furnace, pass through the tubes and return between the lower and upper shells to the outlet at the front of the boiler. The furnace being of large diameter and highest at the back, with considerable space beyond the grate surface, is favorable to good combustion. The tubes are short, direct and proportioned to give the correct area, in order that they may all be filled with hot gases. Most of the soot is carried through the tubes and deposited in the rear smoke box, so that all the heating surfaces of the furnace, tubes and return flue between the upper and lower drum are very effective.

The circulation of water inside the boiler is around the furnace and tubes, up the rear neck into the steam and water drum, where the steam is released, the water passing along the upper drum towards the front, and down the front neck. A semi-circular baffle plate, which is placed about half way around the furnace, causes the down-flowing water to circulate to the lowest part of the shell under the furnace.

It will be seen by reference to the sectional cuts that the feed water enters the rear part of the upper drum, where it meets the current of hot water flowing towards the front, so that as it passes towards the front the temperature is raised to that of the steam and water in the boiler; an opportunity is thus given to drop any sediment or solvent impurities on the bottom of the upper drum, particularly in the pocket formed by a baffle plate placed back of the front neck, a blow-off outlet being provided at that point. Another pocket for the deposit of sediment is provided underneath the furnace, with a blow-off, so that there are practically two mud drums providing for the deposit and removal of sediment before the inflowing water reaches the hot surfaces of the furnace and tubes, where scale would be formed. It is found by experience in using impure water, that it is easy to keep the boiler clean by the regular use of the blow-off cocks, and the usual washing out through the hand holes at the front and back of the lower shell and through the man-hole in the upper drum. In addition, there are two large hand holes in the shell at the rear of the furnace for cleaning between the tubes, the tubes being spaced in parallel diagonal rows, so that a bar may be passed through every row of tubes at the rear of the furnace, where scale will form, if at all. Owing to the rapid circulation of water around the upper part of the furnace and tubes, it is found scale will not form, except at the lower part of the boiler. In cases where exceptionally bad water is used, the furnace and tubes are bolted in, so that by removing a row of bolts passing through the front ring and an exterior angle iron ring, and another row through the rear tube sheet and ring, the entire furnace and tubes may be removed for inspection and cleaning.

Every part of the boiler is open to inspection. A large space is provided under the shell, through which a man may pass and inspect the entire lower half of the shell. The upper half of the shell, drum and necks are open to inspection through the front and rear doors, and, if necessary, the side casings may be removed. A man-hole is provided in the upper drum and numerous hand holes in the lower drum, so that the interior of the boiler may be readily examined.

It is claimed for this boiler that it has the advantage of the Scotch marine and similar types of internally fired boilers, without the large diameter of shell, thick plates and expensive combustion chamber, while giving the lighter weight, less floor space and more perfect circulation of the best boilers of the sectional water tube type, but avoiding the large number of hand holes and joints usually necessary in boilers of this type. As the fire box is internal, surrounded entirely by water, there is no loss of heat, either by radiation or air leakage, which takes place in boilers of the brick-set type; and the expensive repairs incident to brick-setting are entirely obviated.

It has been stated that internally-fired boilers tend to imperfect combustion, on account of the cold surfaces of the furnace, but in this respect they do not differ from return tubular or water tube boilers, in which the water surface is directly above the fire. The long furnace and combustion chamber of this boiler, with greatest height at the back, favors complete mingling of the gases and good combustion.

The manufacturers of the Robb-Mumford boiler say that the best results are obtained by having a rather small grate surface, strong draught, and a thick fire; or, in other words, a high rate of combustion per square foot of grate. They claim that the practice of furnishing a large grate surface, as is frequently done in boilers of the externally-fired type, to increase the capacity of the boiler, is opposed to good economy; first, because if more coal is burned

than the heating surface of the boiler is calculated for, the gases will escape too hot, and, on the other hand, when the boiler is worked at a less capacity, the grate surface is so large that the fire may not be properly distributed over the whole grate, and is liable to have thin or dead spots through which cold air may pass, causing waste and imperfect combustion.

As this boiler consists practically of two steam and water drums similar to those used in water tube boilers, and constructed entirely of steel plate without stays, it is considered to be equally as safe as the best of that type. A battery of 1,000 hp occupies a space of

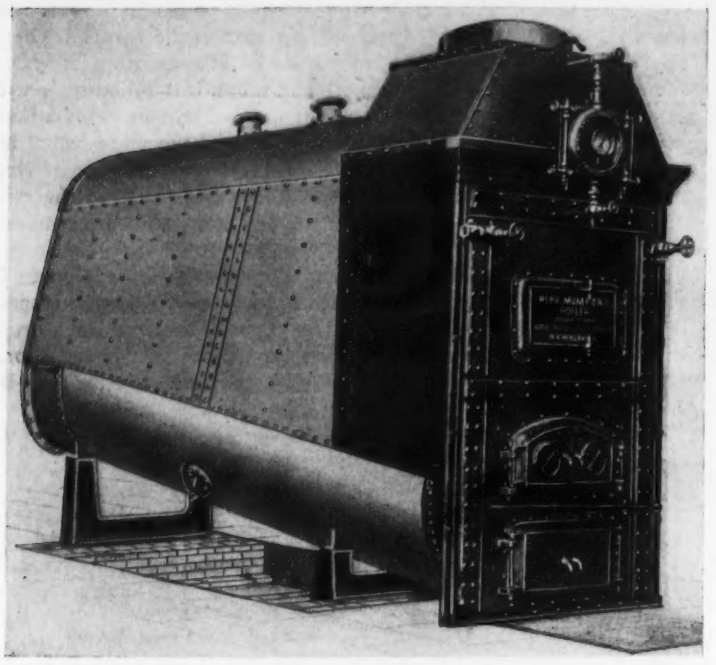


FIG. 2.—PERSPECTIVE VIEW OF BOILER.

about 32 ft. in width by 23 ft. in depth and 14.25 ft. in height. Each unit is entirely distinct and may be completely isolated for cleaning, inspection or repairs. The manufacturers for the United States are the Robb-Mumford Boiler Company, Incorporated, with offices at 135 Broadway, New York, and 170 Summer Street, Boston.

New Combination Ohmmeter.

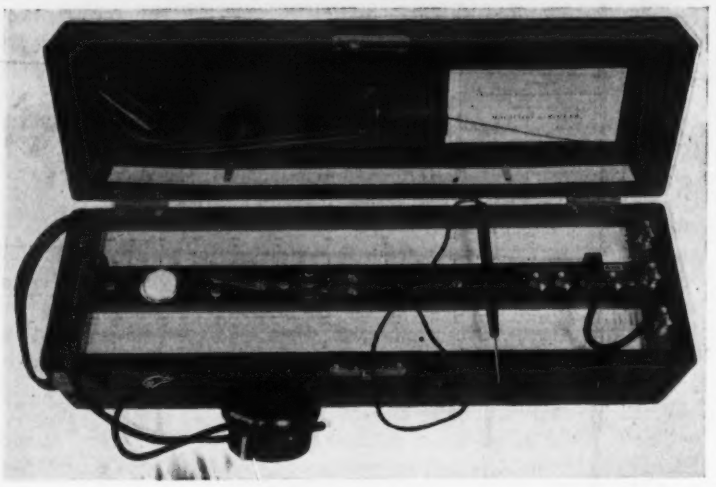
We illustrate herewith a new form of Sage ohmmeter being placed on the market by Messrs. Machado & Roller, the licensees under the Hanchett and Sage patents. As will be seen, this differs from the old form in having added a galvanometer and an induction coil. Two switches are also provided, with the aid of which either the telephone receiver or the galvanometer may be used as the current detector at will, and one applies either direct current from the batteries or alternating current from the secondary winding of the induction coil at will.

The galvanometer is of the D'Arsonval form unaffected by external influences, well balanced so that care in leveling is not required, and of a sensibility even superior to that of the telephone receiver. It is, of course, also unnecessary to place the meter in any particular meridian in order to bring the galvanometer needle to zero.

The galvanometer is a valuable adjunct in that it enables the set to be used where there is too much noise to make the employment of the telephone receiver possible, and further gives a means of working from a false zero in making the Murray test.

The induction coil makes it possible to compare capacities and inductances and to measure the resistance of electrolytes or internal resistance of batteries. It also comes in when locating faults on lines where an e.m.f. exists at the fault, as for instance in a submarine cable where one or more conductors are grounded or both open and grounded. By keeping the telephone receiver circuit closed the e.m.f. at a fault of this kind causes a continuous current to flow which does not affect the telephone receiver, the alternating current from the induction coil of the instrument alone being effective for use in obtaining balance.

The number of cells of battery has not been reduced and the overall dimensions have not been increased, while the weight is only about a pound more than that of the original form of apparatus. It is claimed that tests that have recently been made under the most severe service conditions show this form of meter to be



OHMMETER.

superior in every way to a bridge and galvanometer for the location of faults.

New Desk Telephone Set.

The Atwater-Kent Manufacturing Works, Philadelphia, has brought out a desk telephone set which differs in several respects from the usual form of this type of instrument. It consists in the combination with a nickeled stand of handsomely finished oak box scarcely larger than an ordinary transmitter case. A flexible cord connects this with a terminal block on the wall. On this block is also placed the bell. The sets are made to be used with both the two-end and intercommunicating systems. The self-contained transmitter of the same make, which is always in adjustment, is mounted inside of the box. The receiver is made in one piece and has no parts to become loose. The hook contacts are knife edge, which makes it impossible for acid or dirt to prevent perfect contact. The instrument is finished in a neat and desirable manner.

DESK TELEPHONE.

New Works of "P. & B."

The Standard Paint Company, on the evening of April 22, gave a house warming to its employees and members of the press to celebrate the completion of its new factory buildings at Bound Brook, N. J. On the upper floor of the main building, about 250 x 100 ft., and handsomely decorated with flags, bunting, etc., for the occasion, refreshments were served and dancing was enjoyed.

The newly equipped factory is an evidence of the great success with which the products of this company have met. Since the company's inception in 1886, the "P. & B." insulating compounds, and, latterly, "Ruberoid," have become well known all over the world, and are extensively used.

The new factory is a model in every respect. It is electrically equipped, the power being furnished by a direct-connected engine and generator built by the American Engine Company, Bound Brook, N. J.

The elaborate entertainment furnished at this opening was a complete success through the untiring efforts of Mr. R. L. Shainwald, assisted by Mr. F. F. Vandewater and P. M. Wade.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—There was a moderate demand for money with liberal offerings, the closing rates being 4¼ per cent. for 60 to 90 days and 4½ per cent. for four, five and six months. In stocks there were slightly reactionary tendencies following an advance early in the week, caused by the easing of the money market and the modification of the Northern Securities decision in a way which permits dividend payments pending an appeal of the case. Professional trading supplied most of the activity and there was a decided absence of features. Some interest was shown in the hearing of the charges growing out of the recent attacks upon the management of the Metropolitan Street Railway, although this did not materially influence prices of traction stocks. Brooklyn Rapid Transit was somewhat irregular, although the current reports regarding the company are favorable. The United States Steel stocks were dull, advancing in sympathy with the general list and then declining when the market weakened. Amalgamated Copper showed some weakness. Metropolitan Street Railway reached 133¼, but dropped off and closed at 129¾, being ¾ above the lowest figure, and representing a net loss of 2¼ points on the week's trading. Brooklyn Rapid Transit closed at 65, which was the lowest quotation of the week, and 1½ points net loss. General Electric declined to 192, but recovered some of the loss and closed at 193½, being a net gain of 3 points. Westinghouse common and preferred made net gains of 14½ and 8 points respectively, the closing quotations being 208 and 210. Western Union made a net gain of ½, closing at 85½. Following are the closing quotations of April 28:

NEW YORK.

	Apr. 21.	Apr. 28		Apr. 21.	Apr. 28
American Tel. & Cable	80	75	General Electric	192	192⅝
American Tel. & Tel.	158	160	Hudson River Tel.	..	..
American Dist. Tel	30	..	Metropolitan St. Ry.	131¾	130⅛
Brooklyn Rapid Transit	68¾	65¾	N. E. Elec. Veh. Trns.	..	..
Commercial Cable.	..	..	N. Y. & N. J. Tel.	..	..
Electric Boat	20	20	N. Y. E. V. T. Co.	..	..
Electric Boat pfd.	35	35	Tel. & Tel. Co. Am	..	..
Electric Lead Reduction.	1	1¼	Western Union Tel.	85⅜	85
Electric Vehicle	12	12	Westinghouse com.	208	195
Electric Vehicle pfd.	16	15	Westinghouse pfd.	208	195

BOSTON.

	Apr. 21.	Apr. 28		Apr. 21	Apr. 28
American Tel. & Tel	159	160⅞	Western Tel. & Tel. pfd.	96¾	96
Cumberland Telephone	..	..	Mexican Telephone	1⅜	2⅛
Edison Elec. Illum.	..	..	New England Telephone	135	136
General Electric	..	..	Westinghouse	..	95
Western Tel. & Tel.	20	19	Westinghouse pfd.	..	95

PHILADELPHIA.

	Apr. 21.	Apr 28		Apr. 21.	Apr. 28
American Railways	..	..	Phila. Traction	97⅜	97¼
Elec. Storage Battery.	70*	74	Phila. Electric	7	7⅛
Elec. Storage Battery pfd.	70*	..	Pa. Electric Vehicle	..	..
Elec. Co. of America.	9	8¾	Pa. Electric Vehicle pfd	..	..

CHICAGO.

	Apr. 21.	Apr. 28		Apr. 21.	Apr. 28
Central Union Tel.	..	..	National Carbon pfd.	97	96
Chicago Edison	..	..	Northwest Elev. com.	..	..
Chicago City Ry	..	205	Union Traction	7⅛	6¾
Chicago Tel. Co	..	..	Union Traction pfd.	37	33
National Carbon	24¼	24¼			

*Asked.

INTERNATIONAL WIRELESS COMPANY.—Details are given as to the organization of the International Wireless Telegraph and Telephone Company, $7,500,000 capital stock, of New Jersey, controlling the inventions of Prof. A. E. Dolbear, C. E. Collins and H. Shoemaker. Mr. Fred G. Smith is president, and W. B. Averill, vice-president; Jacob Schiff, Edgar Van Etten, Henry L. Sprague and C. B. Walters are among the incorporators of the company. The International Company has taken over all the property, patents, etc., of the Consolidated Wireless Telegraph and Telephone Company, which had a capital stock of $25,000,000, and was the successor of the American Wireless Telephone and Telegraph Co. Dr. G. P. Gehring, of Philadelphia, was the chief promoter. The American Company had a capital of $5,000,000, and licensed six subsidiary companies, each capitalized at $5,000,000. The terms of the license were that the parent company should receive a stipulated royalty upon the sales of all stock. The promoters of one of the subsidiary companies are said to have sold some 800,000 shares, realizing about $200,000 therefrom. It is claimed that the money derived from the sale of these shares was diverted to the pockets of the promoters of the subsidiary companies, and was not used in the development of the wireless system. The Consolidated Wireless Telegraph and Telephone Company, was therefore organized to put an end to the career of these subsidiary concerns. Its stock is still purchasable from the company at from 50 to 75 cents per share. The stock of the International Company is not yet offered to the public. There are said to be 61 patents, 9 actual or prospective stations, and a copyright on the word "aerogram."

CHICAGO UNION TRACTION COMPANY IN DEFAULT.—A Chicago dispatch states that the Union Traction Company was virtually declared in default on April 22, when it was thrown into the hands of the United States Court. Three judgments aggregating $1,100,000 were entered against the company. The judgments were in favor of the Guaranty Trust Company, of New York, and were entered specifically against the Chicago Union Traction Company, the Consolidated Traction Company, the North Chicago Street Railway and the West Chicago Street Railway Company. The charter of the Chicago Union Traction Company appears to be such that a direct receivership could not be applied for, so the action in judgment proceedings was resorted to. The judgment against the North Chicago railway is for $570,052.66; against the West Chicago company for $280,440; against the Union Traction Company, $217,690.66. James H. Eckels, president of the Commercial National Bank, and Marshall E. Sampsell, clerk of the United States Circuit Court, were chosen to act as joint receivers for the properties.

EVANSTON (ILL.) YARYAN COMPANY.—The plant of the Evanston (Ill.) Yaryan Company, which was bid in at foreclosure sale last week by Lyman A. Walton, vice-president of the Equitable Trust Company, for $219,295, has been conveyed by him to the Evanston Heating Company, organized to succeed the Yaryan Company. The consideration is $285,000. The purchasing company executed a trust deed to the Illinois Trust & Savings Bank as trustee for $400,000, of which $125,000 is to be issued immediately, to be followed by additional issues from time to time in connection with the improvement and enlargement of the plant not exceeding in the aggregate 85 per cent. of the company's subsequent additional expenditures. The bonds run ten years and bear 5 per cent. interest. It is understood that interests friendly to the Chicago Edison Company are behind the purchase.

BOSTON EDISON INCREASE.—A special meeting of the Boston Edison Company will be held in May to authorize the issue of 8,640 shares of treasury stock and authorized by the gas commissioners to be issued at $200. This stock will be offered, on the basis of one new share for each ten now held, to stockholders of record on the date of special meeting. In the event that the gas commissioners authorize stockholders to subscribe for the new 20,000 share issue just voted at $200 a share, $4,000,000 will be realized, of which amount $2,250,000 will be used in making payments on the recently acquired electrical business of suburban companies, leaving $1,750,000 for improvements.

CUMBERLAND TELEPHONE.—The Cumberland Telephone and Telegraph Company (Bell system in some Southern States) reports for two months ending March 31, as follows:

	1903.	1902.	Changes.
Gross	$548,764	$488,664	Inc. $60,100
Expenses	381,318	356,390	Inc. 24,928
Net	$167,446	$132,274	Inc. $35,172

Subscribers number 96,168, against 81,621 in March, 1902, an increase of 14,547.

DIVIDENDS.—The directors of Westinghouse Electric & Mfg. have declared the quarterly dividend of 1¾ per cent. upon the assenting stock, payable May 15 to stock of record April 30. The Chicago Edison directors have declared the regular quarterly dividend of 2 per cent. payable May 1. The directors of the American District Telegraph Company have declared the regular semi-annual dividend of 1 per cent., payable May 15. The National Carbon Company has declared the regular quarterly dividend of 1¾ per cent. on the preferred stock, payable May 15.

THE FALL RIVER (MASS.) AUTOMATIC TELEPHONE COMPANY, after charging off depreciation has paid a quarterly dividend of 1¼ per cent., and has a surplus left. The number of subscribers' stations is over 1,000, and applications are being received daily. It is claimed that the expense as well as the plant investment shows a decided decrease per subscriber with growth of the exchange. The increased number of telephones in operation has shown no increase in number of troubles, and no necessity for additional help to take care of the system.

MONEY TO BURN.—The *New York Sun* gives space to the following curious item: "There is current in certain stock market circles the strange story that a crowd of operators with headquarters in a big Broadway building has been accumulating for several months past a large surplus of cash. There has been, it is said, heavy liquidation of stocks to swell the mysteries fund, the present proportions of which are estimated in figures that would excite scepticism but for the apparent sincerity with which the information is given. Various imaginary reasons have been assigned for the concentration of so much money. The matter, naturally, has given rise to a great deal of talk, and it is taken for granted that an important deal is foreshadowed, but the nature of it is a profound mystery. The crowd in question is heavily interested in traction and lighting affairs. Everything about the story is extremely vague, which, of course, gives it an increased speculative interest."

CUYAHOGA TELEPHONE COMPANY.—The directors of the Cuyahoga Telephone Company, Cleveland, Ohio, have agreed upon a plan for refinancing the company, to be submitted to a vote of stockholders on May 21. It provides for the reduction of the capital stock from $3,000,000 to $1,500,000, and the issue $2,000,000 of 6 per cent. cumulative preferred stock to be offered to present stockholders at 70. This would net $840,000, for which $569,348 would go to the Federal Telephone Company in payment of debts due that company, and the remaining $270,662 would go for immediate improvements. The remaining $800,000 of the preferred stock is to be held in the treasury and sold later at not less than $80 per share. The Cuyahoga Telephone Company has paid the back interest on its bonds and is now earning a good surplus above its charges.

MICHIGAN TELEPHONE COMPANY.—The Union Trust Company, of Detroit, as receiver of the Michigan Telephone Company, has filed a petition in the United States circuit court asking for authority to issue $50,000 worth of receiver's certificates, payable within three months from the date an order is issued, and carrying interest at a rate not exceeding 6 per cent. The $50,000 thus raised is to be used to construct as a part of the receivership property such telephone wires and conduits as may be necessary to connect the different parts of the system, which the petition alleges is now being done by apparatus that did not pass under the control of the trust company when it was appointed receiver. This refers to the old Detroit Telephone Company equipment, which, it is understood, will now be entirely separated from the Michigan plant.

MASSACHUSETTS LIGHTING CONSOLIDATION.—The consolidation of Massachusetts lighting properties recently set on foot now includes five companies, whose capital stock, price paid for control, gas output and electric lamp capacities for year ended June 30, 1902, are as follow:

	Cap. stk.	Price pd.	Gas out.	Elec. lamp.
Chelsea	$300,000	125	43,412,200	16,200
E. Bos. Gas	275,000	50	68,881,990	.....
N. & W. G.	250,000	300	123,596,000	14,970
Som. E. L.	200,000	185	.....	22,806
Woburn L. H. & P.	175,000	110	.....	15,200
Total	$1,200,000	...	235,890,190	69,176

CONSOLIDATION IN COLUMBUS.—It is reported in Columbus that a consolidation of the Columbus Edison Company and the Columbus Railway Company has been practically concluded. By virtue of the agreements of consolidation, it is stated that the stock of both companies will be taken by a holding company, the capitalization of which has not yet been made public, and the stock of both the companies will be guaranteed dividends. The capital stock of the Columbus Railway Company is $6,000,000, and of the Columbus Edison Company $1,000,000. The latter controls the two electric lighting and power plants of Columbus.

BOSTON WEST END.—Stockholders in the West End Street Railway Company have voted to increase the capital stock $454,250 by the issue of 9,085 new shares, the par value of which is $50, thus increasing the common stock of the company from 181,700 shares, of the par value of $9,085,000, to 190,785 shares, of the par value of $9,539,250. The new stock is issued for the purpose of providing means to repay to the Boston Elevated Railway Company amounts expended by it for the permanent additions, alterations and improvements on the property of the West End Company.

FEDERAL TELEPHONE COMPANY.—The Everett-Moore syndicate, Cleveland, Ohio, is considering plans for refinancing the Federal Telephone Company. It is probable that a new company, with reduced capital stock, will be formed to take over the assets and liabilities of the old company.

MARCONI COMPANY'S ANNUAL MEETING.—The annual meeting of the stockholders of the Marconi Wireless Telegraph Company of America was held last week in Jersey City. The principal business of the meeting was to elect successors to three directors whose terms had expired. Two of these, Samuel Insull, of Chicago, and John W. Griggs, of New Jersey, were re-elected. John D. Oppe, manager for the Marconi Company, of Canada, was chosen to succeed Commander J. D. Kelley, United States Navy.

BOSTON EDISON INCREASE.—At a special meeting of the Boston Edison Electric Illuminating Company, the stockholders authorized the directors to petition the gas and electric commissioners for authority to issue 20,000 shares of new stock, the proceeds to be used for general increase of company's business, but principally for the acquisition of suburban companies.

Commercial Intelligence.

THE WEEK IN TRADE.—Cool weather in some sections of the country and numerous labor troubles have exercised some retarding influences in trade development, yet, notwithstanding these, the conditions were satisfactory, generally speaking. An easing in money rates in nearly all markets is an encouraging feature, but one not unusual at this time of the year. Collections continue to improve slightly but steadily. The manufacturing industry was never so active, and railroad earnings continue large. Foreign crop reports are favorable to American producers. In Germany the crop conditions are less hopeful than they were one or two years ago, and French reports are not altogether satisfactory. The remission of grain duties in the new British budget has been temporarily favorable to export business. In the labor situation the usual spring unrest is visible in many lines, and the building trades are being harassed by numerous strikes. Pig iron has eased in price, and buyers are backward, evidently hoping for further concessions, while the latter part of the year's requirements are still reported unplaced. Against this is to be noted the strength of steel and finished products in nearly all lines. Steel billets and sheets are very scarce. Much new work has been postponed because of inability to get supplies. The demand for structural materials is reported undiminished, notwithstanding the uneasiness in labor circles. The volume of new work offered and projected is heavy. In copper, the situation is unchanged; producers are maintaining nominal prices and consumers are not buying. During the week, offers of Lake copper were as low as 14⅛c., but no buyers could be found. The producers' prices are 15a15¼c. for Lake and electrolytic, and 14½a14¾c for casting stock. The business failures for the week ending April 23, as reported by *Bradstreet's*, numbered 152, against 160 the week previous, and 181 the corresponding week last year.

CONTRACT FOR MEXICAN LIGHTING PLANT.—The contract has been let to a Mexican concern for the equipment of the proposed electric lighting plant for the City of San Juan Bautista, capital of the State of Tabasco, to which reference has recently been made in these columns. The plant will be operated by the Compania Electro Motriz Tabasquena. The initial equipment will take care of 50 arc lamps and 3,000 incandescent lights. It is expected, however, that the installation will be very largely increased later on. The importing and exporting firm of Polte, Reyes & Castro, of Tiburcio 7, Mexico City, has secured the initial contract. The equipment, etc., will be purchased by them in the United States.

MORE CARS FOR PORTO RICO ROAD.—The San Juan Light & Transit Company, which operates the existing electric traction system in San Juan, Porto Rico, and is controlled by J. G. White & Co., is about to order some more cars. Those now in use were built by the American Car & Foundry Company and the Stephenson Car Works. The trucks are Peckham. The motors—35 hp type—were supplied by the General Electric Company.

LIGHTING OUTFIT FOR MANILA.—Mackenzie, Quarrier & Ferguson, Inc., 114 Liberty Street, New York, has secured an order for a 14-in. x 13-in. Harrisburg Standard engine, belted to an alternating-current General Electric generator of 100-kw capacity for shipment to Manila for United States Government lighting work.

CUBAN LIGHTING AND TRACTION FRANCHISE.—An electric light and traction system is to be installed in the City of Santiago, Cuba, a concession having been granted to Eduardo J. Chibas, contracting engineer of that city. The initial length of the road will be five miles.

BRAZILIAN MINING PLANT.—A British syndicate which is represented in Rio Janeiro by Edward H. Tyler, formerly engineer of Arens Brothers, of that city, intends to construct an extensive electrodynamic mining plant in that part of the world.

RONEY STOKER SALES.—Westinghouse, Church, Kerr & Co. have recently received the third order for Roney mechanical stokers from the Potomac Electric Power Company, Washington, D. C. The Potomac Company is the newer coporation which has taken over the properties of the U. S. Electric Lighting Company, of Washington, D. C., which formerly operated a large lighting plant at the corner of Fourteenth and B Streets. This plant has previously been partially equipped with another type of furnace. A new equipment of four 450 B. & W. boilers, fitted with Roney stokers, was rushed into service in the early winter to aid in sustaining the winter peak loads upon the plant, and their satisfactory operation has resulted in the provision for extensions above noted. The Roney stoker equipment at present aggregates 2,700 hp. The New York Central and Hudson River Railroad Company have also ordered Roney stokers for equipping the boiler plant of their new elevator, at Weehawken, N. J. The equipment will comprise four stokers operating under 2,000 hp of Aultman and Taylor water-tube boilers. The International Railway Company, of Buffalo, N. Y., have placed the sixth order for Roney stokers, increasing their present capacity to 6,900 hp. The Ingersoll-Sergeant Drill Company will install twelve stokers in their plant at Phillipsburg, N. J. Roney stokers of various sizes have also been sold to the Stirling Company, for Berwind White Coal Mining Company, Winber, Pa.; the American Bridge Company, the ninth order; the American Locomotive Company, the fifth order, and the Pennsylvania Railroad Company, for Altoona, Pa., the seventh order. The latter consignment will be installed in the new extension to the boiler-house serving the car shops at this point. This boiler-house was designed and erected by Westinghouse, Church, Kerr & Co., and also a similar boiler-house for serving the machine shops. The boiler and stoker equipment in the latter has already been duplicated, and similar extensions are under way for the boiler-house serving the car shops.

NIAGARA RESEARCH LABORATORIES.—This is the name of a $100,000 company which has filed incorporation papers at Albany. Its object is stated as follows: To maintain a research laboratory for scientific investigation at Niagara Falls; do analytical and experimental work for the general public; act as consulting engineers, and experts in perfecting or improving existing processes; rent space, power and the use of its laboratories for physical, chemical and electrochemical investigations; manufacture and sell chemicals and allied products, apparatus and supplies, etc. The primary object of the members of the new company is original research. They propose, however, to promote the interests of theoretical and applied electrochemistry and electrometallurgy by offering to experimenters for a reasonable sum the resources of their laboratories and the aid of experienced men. The technical men in the company are three young engineers—F. M. Becket, R. A. Witherspoon and L. E. Saunders—graduates of scientific schools, who have been for the last few years hard at work with electric furnaces, etc., aiding in the development of the processes now in successful operation at Niagara Falls. Among the directors for the first year are J. G. White, of the firm of J. G. White & Co., of New York City; W. B. Rankine, vice-president of the Niagara Falls Power Company; W. S. Gray, of New York City, a dealer in chemicals; Norman M. Pierce, of Binghamton, N. Y.; Henry J. Pierce, E. B. Stevens, W. G. Case and Dr. Elmer Starr, of Buffalo. It is understood that Mr. Stevens will be elected president of the company and Mr. Rankine vice-president.

SOME TRUMBULL FOREIGN AND DOMESTIC ORDERS.—The Trumbull Electric Company, of Plainville, Conn., through its New York offices, Electrical Exchange Building, which are under the management of Mr. Thomas D. Watson, reports recent receipt of a number of substantial orders for its specialties for shipment to various foreign countries. Frank A. Cundill, of 96 Wall Street, New York, acting on behalf of the British electrical engineering and contracting firm of Healing & Co., Yokohama, has sent in a large order for assorted switches. Anderson & George, of Shanghai, China, have been heavy purchasers for some time past. Arthur H. Merriam, of 132 Pearl Street, New York, has also purchased a quantity of assorted switches and rosettes for export. The Trumbull people have a big run at present in their combination switches for domestic consumption. The New England Electric Company, of Waterbury, Conn., is ordering these specialties at the rate of 2,000 per month. A lot of assorted switches has been ordered by the Delaware, Lackawanna & Western Railroad for signal purposes. The Carleton-Chase Electric Company, Havemeyer Building, New York, has ordered a complete line of knife switches varying from 15 to 200 amp. as well as about 10,000 assorted rosettes. The Trumbull Company has just decided to build a new addition to its factory. The manufacture of panel boards is contemplated.

WESTINGHOUSE TURBINE SHIPMENTS FOR AFRICA.—An interesting shipment has recently been made from the shops of the Westinghouse Machine Company, Pittsburg, Pa., of the first turbines of a large size and of American manufacture to be exported from this country. The shipment consisted of two 1,000-kw Westinghouse generating units of the most recent design. They are destined for light and power service in the De Beers mines, at Kimberly, South Africa. Steam turbine equipments have also within the last month been shipped from the Pittsburg factory, as follows: The B. F. Goodrich Company, Akron, Ohio, one 400-kw unit for supplying light and power to shops; The Johnson Harvester Company, Batavia, N. Y., one 400-kw unit for furnishing power to shops; The Consolidated Railways Light and Power Company, Wilmington, N. C., one 400-kw unit for railway and lighting service; The Nassau Light and Power Company, Roslyn, L. I., one 400-kw unit for local lighting, and S. D. Warren & Co., Cumberland Mills, Me., one 400-kw unit for furnishing light and power to the company's mills located at this point.

THE GENERAL ELECTRIC POWER COMPANY, LTD., of Germiston, Transvaal, South Africa, is calling for bids for the supply of one 1,000-kw and two 1,500-kw, 3-phase, 60-cycle, direct-connected alternators. Bids are asked for both steam turbines and reciprocating engine sets, in order to determine which is best suited for its work. These machines are for extension of the company's existing plant, which supplies current for power and other purposes to a neighboring group of mines, and further considerable extensions are contemplated. The inquiries were made locally, as all such machines are purchased direct through Transvaal representatives of Continental, English and American firms.

ALLIS-CHALMERS.—At the last meeting of the board of directors of the Allis-Chalmers Company, held in New York April 15, the regular quarterly dividend of 1¾ per cent. was declared on preferred stock. The volume of business on the books of the company to-day far exceeds that of any time since the organization of the company, notwithstanding the fact that the output of the plants has been increased to a large extent. The company can see no abatement of prosperity in its various branches of manufacture. There seems to be an unlimited demand for all kinds of high-grade machinery which is certainly a good indication that prosperity is enjoyed in all lines of manufacture.

PITTSBURG AND MONTANA COPPER COMPANY.—Westinghouse, Church, Kerr & Co. recently received an order for the entire mechanical equipment of a new smelter, to be shortly erected in the vicinity of Butte, Mont. The equipment comprises: two 160-hp Westinghouse compound engines, driving Connersville blowers; one 85-hp Westinghouse compound engine, driving a 45-kw D. C. 125-volt generator, with switchboard; two Westinghouse standard engines; four Roney mechanical stokers for four 250-hp B. & W. boilers.

THE NERNST LAMP COMPANY, of Pittsburg, Pa., through the H. C. Roberts Electric Supply Company, of Philadelphia, has secured the contract for lighting the new Roberts Hall, Haverford College, Haverford, Pa., with two, three and six-glower Nernst lamps. The main auditorium of the college is also to be lighted by Nernst lamps. The Westinghouse Trust Company Building, of Washington, Pa., has been fitted throughout, including offices and billiard-room, with two- and three-glower Nernst lamps.

CEILING FANS FOR CHINA.—The Federal Electric Company, Washington Life Building, New York, has secured a contract through Fearon Daniels & Co. of China, 96 Wall Street, for alternating-current ceiling fans to be shipped to China for Shanghai. This makes the third order secured through the same source and for the same destination. The value of the present contract is about $3,000. The Federal Company has just taken a good-sized order for Standard Underground rubber-covered wire for Mexico for a lighting plant.

THE SHERWIN WILLIAMS COMPANY, a large paint manufacturing concern operating several factories in United States and Canada, have purchased a Westinghouse steam turbine power outfit, for their Cleveland factory, to be direct-connected to a 200-kw, 2-phase turbo-generator. The current to be generated at 440 volts, and 60 cycles will be used for general power and lighting puposes throughout the factory.

SUPPLIES WANTED.—The Crookston Waterworks, Power & Light Company, of Crookston, Minn., Mr. W. F. McNally secretary, are in the market for one mile of vitrified clay conduit for underground work, and 6,000 ft. of stranded bare cable for overhead feeders, all 500,000 circular mils.

PRETORIA, SOUTH AFRICA, will, it is stated, install an electric light and traction system to cost $1,250,000

THE AUTOMATIC ELECTRIC COMPANY, of Chicago, has begun the shipment of automatic telephone equipment to the Dayton Home Telephone Company, of Dayton, Ohio, and the Citizens' Telephone Company, of Grand Rapids, Mich. The Dayton Company will begin business with 6,000 stations, and its ultimate capacity will be 19,000. The Grand Rapids Company will have a present installation of 5,000, with an ultimate capacity of 19,000. Both of these companies have erected new buildings, which were designed especially for the automatic exchange. No party lines will be used. The Automatic Electric Company is also manufacturing complete equipment for the Citizens' Telephone Company, of Columbus, O., in which plant 7,000 stations will be installed at first, with an ultimate capacity of 19,000. The Northeastern Telephone Company, of Portland, Me., has also placed an order with the Automatic Electric Company for 2,500 telephones and switches, the switchboard to have a capacity of 10.000. Out in Iowa, the recently-organized Commonwealth Telephone Company has placed an order with the Automatic Electric Company for the equipment of 1,200 stations, with a capacity of 10,000. An order has also been given by the Wettstein Construction Company, which will build the new exchange in Burlington, Iowa. This order calls for the present equipment of 800 stations and an ultimate capacity of 10,000.

THE AMERICAN RIVER ELECTRIC COMPANY.—Articles incorporating the American River Electric Company have been filed in California. The capitalization is $2,500,000, and San Francisco is named as the principal place of business. Among the company's objects are the generation of electric power, which is to be transmitted from a point on the American River near Placerville, Cal., to Stockton, for lighting and power purposes. Mortimer Fleishacker, Herbert Fleishacker and A. J. Hechtman have been planning this system for some time. The new company has perfected its water rights on the American River, and has let contracts for a 75-mile double-pole line, which after leaving Placerville, will extend to Plymouth, Amador City, Sutter Creek, Jackson, San Andreas, Lodi and Stockton. Contracts have been let for some of the machinery, and Mortimer Fleishacker says that the quick deliveries promised will enable them to operate the plant by the close of this year. While the company is desirous of supplying current in Stockton for lighting purposes it will not depend largely upon that for its revenue, as the rich mining districts of the Mother Lode will furnish a good market for electric power. The initial installation will be 5,000 hp.

THE KOKOMO, MARION AND WESTERN TRACTION COMPANY has filed articles of incorporation and plans with the Secretary of State of Indiana. This company has acquired the Kokomo Railway and Light Company, and has commenced the construction of 33 miles of road over a private right of way, connecting Kokomo Marion and intermediate towns. Later on it is proposed to build 47 miles of road east of Marion. This will be an over-head trolley line of single-track construction, and the power house of the Kokomo Railway & Light Company will be used in the operation of the road. The contract for the road-bed has been let to the Indiana Inter-urban Construction Company, of Kokomo. F. F. Van Tuyl & Co., of Detroit, are the consulting engineers for both the railway and the construction companies. It is proposed to push the construction of the railroad as fast as possible, and to operate 10 miles of the road by the 4th of July. That the completion of the road is to be pushed with all possible haste will be gathered from the fact that the company was organized, the articles of incorporation and plans filed, and the actual work of construction begun in a little more than one week.

CONTINUOUS RAIL JOINT COMPANY.—Messrs. Geo. G. Frelinghuysen and Fred'k. T. Feary, representing the Continuous Rail Joint Company of America, have concluded the purchase of about twenty acres of land at Troy, N. Y., with the rolling mills, machine shops and numerous other buildings formerly owned by the Troy Steel Company, part of which they have been operating under lease for the past three years. The property has a dock frontage on the Hudson River, and the New York Central Railroad runs through it. The new switch has just been completed from the New York Central Company's tracks around the rolling mill. The Wynantskill Brook runs across the entire plot, giving an excellent and constant supply of fresh water. The plant will hereafter be known as the Albany Iron & Steel Works Department, of the Continuous Rail Joint Company of America. The output of the products of the company will be greatly increased. In railroad circles the Continuous Rail Joints are universally liked, and fifteen thousand miles of track have been equipped with this appliance. The general offices have always been and will remain at Newark, N. J.

ST. LOUIS EXPOSITION PLANT.—The 500-hp Duerr marine boiler, which was taken out of the battery of boilers of the German man-of-war *Sachsen* for exhibition at the Louisiana Purchase Exposition, raised steam for the first time April 22, and operated the 300-hp, high-speed, automatic, tandem-compound engine supplied by the Buffalo Forge Company, of Buffalo, N. Y. This was the first work done by the pre-Exposition power plant. Besides the Duerr boiler and the Buffalo engine there were placed in operation a 200-kw alternator, built by the Stanley Electrical Manufacturing Company, of Pittsfield, Mass.; a Sorge-Cochrane feedwater heater and purifier and two duplex steam-driven boiler feed pumps, with a capacity of 100 gallons per minute against a boiler pressure of 150 pounds to the square inch, furnished by the National Steam Pump Company, of Upper Sandusky, Ohio. All these machines were entered as exhibits in the Machinery Department. Two Morrin-Climax water-tube boilers, with a combined rating of about 700 hp, supplied by the Clonbrock Steam Boiler Company, are now being installed, and one will be ready for service before the dedication.

MECHANICAL STOKERS FOR BOSTON EDISON.—The Boston Edison Company has recently purchased from Westinghouse, Church, Kerr & Co., a complete equipment of Roney mechanical stokers, to be installed in its new central station, now in process of construction. The station is located in South Boston, on the water front, and, it is understood, will be eventually the main station of this company. The new plant is arranged for steam turbo-generating power units, and the design of the building and equipment provides for future extensions to any desired capacity. The boilers are of the B. & W. 500-hp water-tube type, and are arranged in batteries of eight boilers each, seven of which aggregate sufficient capacity for supplying one power unit, with an eighth as a reserve. The first consignment will comprise eight boilers aggregating 4,000 hp, each fitted with rocking-grate stockers of the Roney type.

MUNICIPALITIES IN ENGLAND.—A special meeting of the Salford Borough Council was recently held to consider the placing of contracts for the new tramcars required for the borough, and after a very animated discussion, lasting nearly three hours, the recommendation of the Tramways' Committe was approved, and the contract for fifty tramcars at approximately $3,700 each, was given to the Westinghouse Company. The London County Council recently received tenders covering the switchboard installations for the sub-stations at the Elephant and Castle, New Cross and Camberwell for the tramways, the contract being awarded to the British Westinghouse Electric & Manufacturing Company, Limited. This contract amounts to approximately $27,000.

BALL ENGINE ORDERS.—The Ball Engine Company, Erie, Pa., has received an order for two engines of 400 hp, from the Washington Electric Light and Power Company, Washington, Pa. The Franklin Electric Light Company, Franklin, Pa., has also purchased a 150-hp engine from the Ball Engine Company. The Beloit Iron Works, Beloit, Wis., have purchased a 70-hp engine arranged for direct-connection to a Northern generator, from the Ball Engine Company, which also secured an order for four vertical cross-compound engines, each direct-connected to 150-kw Crocker-Wheeler generator, for the new First National Bank Building, of Chicago.

A MODERN BAKERY.—A novel application of electricity is a recent installation of the Sprague Electric Company's direct-current motors in the new bakery of the American Pastry and Manufacturing Company, in East Fifteenth Street, New York City. A large number of electric motors will be used to operate the machines for mixing dough for crackers, biscuits and pies. An ingenious apparatus has also been perfected for electrically operating the ovens, which is a new departure in this industry.

WORCESTER WIRE WORKS.—Improvements in power facilities will be made at the Worcester (Mass.) works of the American Steel & Wire Company, the United States Steel Corporation. A number of engines will be compounded and condensers installed, and electric motors will be installed to do away with shafting. It will probably be necessary to put in a new engine with direct-connected generator, to provide the necessary current. The works were never so busy as now.

PLANT FOR ELMIRA, N. Y.—The Elmira Water, Light and Railroad Company, Elmira, N. Y., are installing a 300-kw 60-cycle Westinghouse rotary, which will be used to handle their day motor load. At night it will be driven mechanically, giving alternating current and 3-wire 500 and 250-volt direct current.

BUCKEYE ENGINE ORDERS.—The Buckeye Engine Company, of Salem, Ohio (Mr. Paul Bigelow, New York), has recently secured several contracts for engines for driving generators. The Ingalls Building, at Cincinnati, Ohio, is to be equipped with a 10-in. x 14 in. simple engine, which is to be used for lighting purposes. A 7¾ in. x 12 in. simple engine has been ordered by the New Amsterdam Gas Company, 340 Third Avenue, New York. The same concern has requisitioned for a 16½ in. by 16 in. simple engine for installation in its Ravenswood (L. I.) plant. Both these will be utilized for power purposes. The Pittsburg and Conneaut Dock Company, of Conneaut Harbor, Ohio, has ordered two 20 in. by 38 in. by 36 in. compound engines for power use. The Pennsylvania Railroad will install an 18¾ in. by 30 in. simple engine in its Cleveland, Ohio, shops, and an engine of similar size and type has been ordered for its Erie (Pa.) shops. Both these machines are for lighting use. The Union Stock Yards and Transit Company, of Chicago, Ill., has sent in orders for a 16½ in. and 28½ in. by 30 in. compound engine; also for a 14¼ in. and 25 in. by 18 in. machine, for both light and power. The Dayton (Ohio) Arcade Company Building is to be equipped for lighting purposes with a 14¼ in. and 25 in. by 21 in. compound engine; also a 11 in. and 19 in. by 16 in. one. The Norfolk and Western Railway Company has ordered two 14¼ in. and 23 in. by 16 in. compound engines for its Roanoke (Va.) shops, for lighting. The Fletcher Paper Company, Alpena, Mich., will be furnished with a 13 in. by 24 in. simple belted engine for light and power. An 18¾ by 18 in. simple engine has been ordered for light and power by the S. W. Connellsville Coke Company, Leckrone, Pa. The Atlas Furniture Company, Jamestown, N. Y., has requisitioned for a 14¼ in. by 24 in. simple belted engine for light and power. The La Belle Iron Works, of Steubenville, Ohio, will be equipped with a 13 in. by 22½ in. by 30 in. compound engine, for light and power. The New York Mutual Gas Light Company, 36 Union Square, has ordered, for power use, two 13 in. by 18 in. simple, and the same number of 10 in. by 21 in. engines. The Seamless Rubber Company, of New Haven, Conn., will be supplied with a 15¼ in. by 16 in. simple engine, to be direct-connected to a Bullock generator, for lighting. Two pair twin 20 in. by 30 in. engines have been ordered by the Stearns Salt and Lumber Company, of Ludington, Mich. They will be utilized for power purposes. An 18¾ in. by 30 in. simple engine will be installed for light and power in the Wellsville, Ohio, plant of the American Sheet Steel Company. A 15¼ in. by 30½ in. by 33 in. compound engine has been ordered by the Wilmington (Del.) Malleable Iron Company. This engine will be direct connected, for light and power, to a Crocker-Wheeler generator. The new structural material plant of Milliken Brothers, which is to be electrically operated throughout, will be installed with a 14 in. and 28½ in. by 21 in. compound. The generators and motors for this plant will be Westinghouse.

SOME HEINE BOILER CONTRACTS.—The Heine Safety Boiler Company, of St. Louis, Bowling Green Building, New York, reports recent receipt of several substantial contracts for boilers in electrical plants. A 1,500-hp outfit in three units of 500 hp each has been ordered by the Suburban Electric Light Company, of Scranton, Pa. The Taunton (Mass.) municipal lighting plant is to be equipped with three 300-hp boilers. The American Type Founders' Company has ordered two 160-hp boilers for installation in its new plant at Communipaw, N. J., which is to be electrically operated. Edward R. Knowles, 136 Liberty Street, is acting as consulting engineer regarding the matter. The Rockland Light & Power Company is putting an addition on to its plant near Nyack, N. Y., and has ordered a 250-hp Heine boiler. Sibley, Lindsay & Curr Company, which concern operates a large dry goods store at Rochester, N. Y., has ordered a 480-hp boiler outfit in three units of 160 hp each. The boilers will be installed in connection with an electric lighting and general power plant for the establishment. The United States War Department has requisitioned for Heine boilers to be installed in Forts Levett, McKinley and Williams, Portland, Me. The boilers for the first two forts will aggregate about 350 hp each, in three units of 116 hp each. At Fort Williams a small additional equipment will be added to the Heine boilers already installed there. The boilers will furnish power to operate Westinghouse equipment to light the fortifications and to handle the heavy guns, etc. The Schuylkill Valley Illuminating Company, of Phoenixville, Pa., which concern is remodeling its plant, has ordered three 367-hp boilers from the Heine people. The new Whitehall Building at Battery Place, New York, is to be equipped with a 900-hp boiler outfit in three units of 300 hp each. These boilers will furnish power for operating the electrical equipment to be installed in the building. The Bliss factory building now under construction at Third Avenue and Twenty-third Street, New York, is to have a 1,000-hp Heine outfit in four units of 250 hp each. An extensive electric plant is also to be installed.

IMPORTS AND EXPORTS.—The imports into the United States exceeded one billion dollars in the twelve months ending with March, 1903. This is the first time in the history of our foreign commerce that imports in twelve months have exceeded $1,000,000,000. Prior to 1870 they had never reached as much as a half million dollars in a single year, and it was not until 1890 that they reached three-quarters of a million dollars in value, and now, for the first time, they have passed the billion-dollar line. Meantime the exports have grown with like rapidity. In the twelve months ending with March, 1903, the total exports were $1,414,786,954, against $1,001,596,683 of imports, giving an excess of exports during the twelve months of $413,190,271. Exports never reached a half-billion dollars' value in a single year until after 1870. In 1880 they passed, for the first time, the three-quarters of a billion-dollar line; in 1892 they, for the first time, exceeded $1,000,000,000, and in the twelve months ending with March, 1903, they were $1,414,786,954; and should the exports of April, May and June average as high as those for March, they would bring the total exportations for the fiscal year past the $1,500,000,000 line.

EXPORT ORDERS FOR ROCHE BATTERIES, ETC.—William Roche, of 42 Vesey Street, New York, reports having lately taken some heavy orders for his new standard dry batteries, flashlights, gaslighters, etc., for shipment to different parts of the globe. The American Trading Company, 25 Broad Street, New York, has sent in an order for flashlights and gaslighters to be exported to Martinique. The New York Export & Import Company, 56 Pine Street, New York, has contracted for several thousand dry batteries, etc., for shipment to India. Wilhelmi & Co., 116 Broad Street, New York, has just ordered a 5,000 lot of batteries, which are intended for the Chinese trade. Guiterman, Rosenfeld & Co., 35 South William Street, New York, has requisitioned for a large lot to be shipped to England, while for the Australian markets a big order has been secured through R. W. Forbes & Son. The largest order recently secured for the domestic trade came from St. Louis. It called for 100,000 dry batteries.

GROWING PROPORTION OF EXPORT GOODS.—To sum up in a single sentence a comparison by the United States Treasury Bureau of Statistics of production with exportation, in agricultural and manufactured products, respectively, it may be said that, comparing conditions in 1900 with those of 1870, agricultural production has increased 92 per cent. agricultural exportation 132 per cent., production of manufactures 209 per cent., and exportation of manufactures 538 per cent. Percentage of increase in production and exportation of agricultural products and manufactures, from 1870 to 1900 is as follows:

	1870. Value.	1900. Value.	% Inc.
Agricultural products	$1,958,030,927	$3,764,172,706	92.1
Agricultural exports	361,188,483	835,858,123	131.8
Manufactures produced	4,232,325,442	13,039,279,566	209.1
Manufactures exported	68,279,764	433,851,756	537.7

LARGE MEXICAN WATER POWER PROJECT.—One of the most important water power schemes ever projected in Mexico is being pushed forward by James Butler, a capitalist located in Colonia Marez, State of Chihuahua. It is proposed to develop the immense water power of Guaynopa Cañon, at a point called Sale Que Puede, where a large hydraulic plant is to be installed. The head available is no less than 3,000 ft., and the volume at the gate of the penstock, which is planned to be put up, is estimated to be 5,000 cubic ft. per second. It is proposed to supply current for lighting and general power purposes for a large portion of the western part of the State of Chihuahua and to operate the bulk of the sawmills in the Guaynopa forests.

THE STILWELL-BIERCE & SMITH-VAILE COMPANY, of Dayton, Ohio, New York offices, Washington Life Building, has secured a substantial contract for electrically-driven pumping equipment from Frederick Nell, of 95 Queen Victoria Street, London, E. C. Several Victor turbines have also been ordered by the electrical engineering and contracting firm of Town, Mohlan & Seebeck, of Durban, for installation in water power plants for electric railway work in South Africa.

SYRACUSE LIGHTING PLANT.—The electric lighting plant of the Syracuse (N. Y.) Lighting Company is to be largely remodeled. A 2,000-hp equipment will be installed in the first instance. Ultimately the capacity will be 3,000 hp. Four Heine boiler of 500-hp capacity each have just been ordered. Curtis turbines will also be installed.

EQUIPMENT FOR WASHINGTON INSANE HOSPITAL.—Considerable electrical equipment is to be installed in the Government Hospital for the Insane at Washington, D. C. The Heine Safety Boiler Company has taken the contract for the boilers. Nearly 1,600 hp will be put in. There will be five units of 316 hp each.

YUCATAN LIGHTING PROJECT.—The town of Ticul, some 40 miles south of Meridu, capital of Yucatan, Mexico, is to have an up-to-date municipal electric lighting plant. The present illuminating system in that part of the world is oil lamps.

General News.

THE TELEPHONE.

BIRMINGHAM, ALA.—The People's Home Telephone Company, of Birmingham, a competitor of the Bell Company, is seeking to raise rates above the franchise limit, it being represented that the company cannot make money under the present rates.

SANTA ANA, CAL.—The Chamber of Commerce has sent a resolution to the Board of Supervisors asking that there be offered for sale a franchise for the operation of a telephone system on the streets and highways of the county. Thus the chamber puts itself on record as favoring the coming of a new company into the local telephone field.

TRINIDAD, COLO.—The Colorado Telephone Company will build a new exchange at this place, and make other improvements which will cost $80,000.

NAMPA, IDAHO.—The Nampa Automatic Telephone Company, with a capital stock of $20,000, has been incorporated by J. S. Fox, A. K. Stoddard, N. C. Joyner and others.

MARION, ILL.—The Marion Telephone Company has been incorporated with a capital of $15,000. Incorporators: J. B. Bandy, J. C. Mitchell, A. F. White, Joab Goodall.

CORYDON, IND.—The Eureka Telephone Company will build an exchange in Corydon to connect with out-of-town lines. Lainesville is to have an exchange also, and a new line is to be built from Breckenridge to Corydon.

PERKINSVILLE, IND.—The Perkinsville & Lapel Telephone Company has incorporated with a capital stock of $2,500. The principal office and exchange will be in Pleasantville. W. M. Garretson, O. A. House, J. F. Anderson, and A. B. Hoffman, are the incorporators.

PETTYSVILLE, IND.—The Roann Telephone Company, capital stock $15,000, has incorporated to build a telephone system and exchanges through Wabash and Miami counties. G. T. Grimes, Ellis Gonner and T. K. Baker, all of Pettysville, are the incorporators.

SALINE CITY, IND.—The Art Telephone Company, capital stock $7,000, has incorporated to build an exchange in this city and extend lines through Clay County. The directors are Aba Long, Miller Hyde, A. G. Barber, Henry Wagoner and John Fogal, of Saline City.

INGLESFIELD, IND.—The Rural Telephone Company, of this city, has incorporated. The capital stock is $1,000. The company will construct and operate a telephone system in this city and immediate vicinity. Joseph Burston, J. R. Knowles and W. D. Miller, are directors.

VEEDERSBURG, IND.—The Veedersburg Telephone Company has filed articles of incorporation. Capital stock $25,000. The company will construct and operate a system in Fountain, Park and Clay counties. John L. Osborn, J. K. Quinn, D. P. Heftner and C. E. Osborn, are directors.

BROWNSBURG, IND.—The Brownsburg Telephone Company has incorporated with a capital stock of $6,000. The company will establish an exchange here and build and operate lines in Hendricks, Boone and Marion counties. J. S. Thorp, J. R. Flinn and W. H. H. Medsker are directors.

ROCKFIELD, IND.—The Rockfield Co-operative Telephone Company has incorporated with a capital stock of $3,000. This company proposes to establish an exchange and construct and operate a telephone system in this town and throughout Carroll County. F. M. Tyrell, C. L. Wilson and S. M. Causer are directors.

PORTLAND, IND.—The Co-operative Telephone Company has incorporated to establish a telephone system and exchanges in Jay, Delaware, Madison, Randolph, Blackford and Wells counties. The capital stock is $10,000. D. M. Baker, C. N. Hardy, Portland; A. M. Poland, Albany, and J. B. Andrus, Red Key, are directors.

LOGANSPORT, IND.—The Logansport Home Telephone Company has voted to expend $10,000 in extending its lines to Walton, Lincoln, Galveston, Young America, Burrows and other towns, the intention being to locate exchanges and bring the entire territory into connection with the local plant as well as to form a fine local service in the towns mentioned and the adjacent farming territory.

MANILLA, IND.—A telephone exchange and system have been installed here by the Central Union Telephone Company and is now in operation. The construction throughout is on a complete metallic circuit basis. The exchange is connected with the one at Shelbyville and the subscribers have free use of this connection, a 15-cent toll rate to Indianapolis being charged. The rate is $1 per month and many citizens and farmers are clamoring for the service.

LOGANSPORT, IND.—The American Telephone & Telegraph Company has asked for a long-distance franchise in this city. The Home Telephone Company is opposing the grant until the ordinance more fully and explicitly sets out what long-distance service is. The franchise asked for by the American Company might be construed into meaning a local plant service and the Home Company is anxious that no mistake be made. The council and citizens are opposed to a dual system.

ELKHART, IND.—The Lake Shore & Michigan Southern Railroad is making arrangements to construct a private telephone system to connect the division terminals and at each terminal to have an exchange to connect the various offices at that terminal. There will be two No. 8 copper wires from Chicago to Buffalo for the through business, and each terminal exchange will be something of an investment itself. It is understood the work will be begun as soon as the various chiefs can make their estimates for requisitions. The two main line wires will be strung on the telegraph poles already in use. The telephones will be used for general business that does not necessarily require a written record and trains will be governed by telegraph as at present.

LOGANSPORT, IND.—There was a very important joint meeting of the officers and directors of the Logansport Home Telephone Company and of the Ft. Wayne Telephone Company held here on April 9. Recently there was incorporated in New Jersey a corporation known as the Illinois and Indiana long distance telephone lines throughout the East, middle states and the West, long distance telephone lines throughout the East, middle States and the West, connecting with the local exchanges in the above named territory. Steps were taken at this meeting to bring together at a future meeting representatives from all the independent companies of Illinois and Indiana to confer relative to taking stock in the long distance company and thus guaranteeing the extension of its benefits to the plants in these States. A good attendance and a hearty co-operation is anticipated in this enterprise.

EVANSVILLE, IND.—The Evansville Mutual Telephone Company has filed articles of incorporation with the Secretary of State. The company has a capital stock of $390,000, of which $190,000 is preferred and divided into 7,000 shares of $25 each. More than 300 residents of Evansville, including leading business men have subscribed to shares of the preferred stock. The receipts from the sale of the preferred are to be used for the complete installation and equipment of a telephone plant in Evansville and fitting it for service for at least 2,500 subscribers with an ultimate switchboard capacity of 7,200. The preferred stock bears 3½ per cent. interest semi-annually, and is redeemable at par at the end of five years. Every holder of forty shares of preferred may take also one share of common stock, but the common must be surrendered with the preferred and at par. The city has accepted 7,900 shares of stock in the company, which is supposed to represent the value of the franchise granted. The success of the undertaking depends upon the outcome of the suit to oust the Cumberland Company which assumes to have a perpetual franchise and is making elaborate plans for a protracted stay in Evansville. The Cumberland Company is erecting an imposing telephone building and boasts that it will install one of the finest telephone plants in the world. It has the valuable American long distance connections and if the courts sustain its contention it will put an established system and experienced management with unlimited capital against a new system and service, inexperienced political management with limited capital.

DES MOINES, IA.—An ordinance has been prepared and will probably pass the council requiring the telegraph, telephone and electric lighting companies to remove their wires from poles in the downtown district and place them in underground conduits.

LONDON, KY.—J. W. Creech, of East Bernstadt, has purchased the London Telephone Company.

LEXINGTON, KY.—A certificate of amendment was filed by the Bourbon County Home Telephone Company, of Lexington. The capital is changed from $75,000 to $130,000.

LEWISTON, ME.—The Lewiston & Auburn Telephone Company has a capital of $250,000 and not $25,000 as previously stated. It is to instal the Strowger automatic system.

OVID, MICH.—The Ovid Telephone Company is building several rural lines and adding to the capacity of its switchboard.

LANSING, MICH.—The Bell Telephone Company will build two new lines from Charlotte to Saginaw affording improved facilities in the Saginaw Valley.

ALMA, MICH.—The Union Telephone Company has elected officers as follows: S. E. Parkwill, president; J. H. Tilden, secretary, and G. S. Ward, treasurer.

HOWELL, MICH.—The Livingston County Mutual Telephone Company has increased its capital stock from $10,000 to $50,000. Improvements will be made at once.

GRAND RAPIDS, MICH.—The Citizens' Telephone Company will build additional toll lines between St. Joseph, Holland and Benton Harbor. The improvements will cost $20,000.

HART, MICH.—The Oceana Telephone Company has increased its capital stock from $20,000 to $50,000, and is planning extensions to its system. The company has 120 farm-line and 300 exchange subscribers with 45 miles of metallic circuit toll lines. T. S. Gurney is president and G. S. Root, general manager of the company.

RED LODGE, MONT.—At a special meeting of the Montana & Wyoming Telephone Company the company's capital stock was increased from $40,000 to $100,000.

ANACONDA, MONT.—The Allen Gold Mining Company which has filed articles of incorporation here, proposes to build telephone and telegraph lines in connection with its mining enterprises.

TRENTON, N. J.—Judge Kirkpatrick in the United States Court has directed a nonsuit in the case of the Delaware & Atlantic Telephone Company against the township of Pensauken and the Eastern Telephone Company. The Delaware & Atlantic Company sued for $50,000 damages for the cutting down of about one hundred and sixty of its poles in the township of Pensuaken in the spring of 1901.

GRANVILLE, N. Y.—The Granville Telephone Company has increased its capital stock from $30,000 to $50,000.

SALISBURY, N. C.—The Salisbury Telephone Company and the Southern Bell Company have perfected an agreement by which the former service will be greatly improved and connected with the long distance service of the Bell Company.

NEW PHILADELPHIA, OHIO.—The Central Union Telephone Company has completed lines from Navarre and Cambridge to Canal Dover.

NORWALK, OHIO.—The Central Union Telephone Company is erecting a new exchange building and making other improvements at Norwalk.

WARREN, OHIO.—The Warren & Niles Telephone Company has increased its rates on new contracts for residence telephones from $12 to $18 per year.

CONNEAUT, OHIO.—The Central Union Telephone Company is building additional lines between Cleveland and Conneaut. Service between Erie and Conneaut will also be improved.

LOGAN, OHIO.—The Logan Home Telephone Company is building lines to Webb, Summit, Gore and New Straitsville and is planning to connect up all the farmers in Hocking County.

NORTH LEWISBURG, OHIO.—The North Lewisburg Telephone Company is preparing to build a large number of farmers' lines this summer and will extend its system throughout the county.

STRUTHERS, OHIO.—The Central Union Telephone Company (Bell) is preparing to establish a new exchange at Struthers. Heretofore a few citizens have had communication through the Youngstown exchange.

WEBSTER, OHIO.—The Webster Telephone Company, of Wood County, has incorporated with $10,000 capital stock. Incorporators: M. Jameson, J. A. Stabel, C. F. Fis, C. D. Hagerty, L. E. Philo and Anthony Seifert.

HAMILTON, OHIO.—The Hamilton Home Telephone Company announces that it has closed a contract with the Fitzsimmons Telephone Company, of Cincinnati, whereby it will have toll connection with points in Cincinnati.

GLOUCESTER, OHIO.—The Sunday Creek Valley Telephone Company has been incorporated with a capital of $50,000 to build an independent system here. The incorporators are G. E. Turner, A. F. Turner, A. B. Allen and G. W. Rose.

MARION, OHIO.—The directors of the Marion Home Telephone Company have declared a semi-annual dividend of three per cent. on both common and preferred stock. The company is installing a new section to its switchboard which will accommodate 450 new subscribers.

CLEVELAND, OHIO.—The American Telephone & Telegraph Company is making efforts to secure all the long distance business of business houses of the city and vicinity. Books affording $100 worth of service are sold at 25 per cent. discount and $50 books at 15 per cent. discount.

ADENA, OHIO.—The Adena Exchange Telephone Company, of Jefferson County, has been incorporated with $5,000 capital stock, to build lines connecting Adena, Smithfield, Hopedale, Harrisville and Unionvale. The incorporators are Mills Hall, C. A. Ickes, J. G. Ickes, W. H. Thompson and J. W. Smith.

DAYTON, OHIO.—The new automatic exchange of the Dayton Home Telephone Company is nearing completion and it is expected it will be in operation with 5,000 subscribers within thirty days. A contract has also been placed for the installation of an automatic system at Columbus which is controlled by the same people.

CLEVELAND, OHIO.—The Cuyahoga Telephone Company will ask the new city administration for permission to increase its rates, and if the permission cannot be secured, it is stated the rates will be raised anyway, as it is claimed the city cannot control the matter of rates. The new rates will probably be $24 per year for four-party line service, $36 for two-party line service; $48 for full metallic residence service and $60 per year for full metallic business service. The Cuyahoga Company is planning to issue $1,000,000 of 6 per cent. cumulative preferred stock at 60, which will realize $600,000. This would pay off the debt to the Federal Telephone Company and leave $150,000 for improvements to the Cuyahoga system.

GUTHRIE, O. T.—The Grant County Telephone Company, of Wakita, has secured a charter to construct and operate telephone lines for twenty years. The capital stock is $100,000. The men interested are C. L. Bickerdike, W. H. Garrett, Sand Creek; W. E. Lemon, J. J. McMullin, P. H. Loomis, M. B. Rutherford, E. M. Garrett, J. E. Garrett, Wakita; Chas. N. Ernest, Medford.

UNIONTOWN, PA.—A number of Uniontown capitalists having recently purchased the entire holdings of the Tri-State Telephone Company are at present engaged in extending their lines, principally in Fayette County. The system will, it is claimed, be second to none in equipment and service. Mr. S. M. Graham of this place is president.

CLARKSVILLE, TENN.—Arrangements have been completed for the consolidation of the Houston Telephone Company and the Home Telephone Company of Clarksville. This will be one of the strongest independent telephone concerns in the State.

DALLAS, TEX.—It is announced that the Southwestern Telegraph & Telephone Company has acquired the system of the Northwestern Telephone Company, an independent organization operating 600 miles of line along the Texas and Pacific Railway west of here.

AUSTIN, TEX.—The toll lines of the Indianola and Lone Star Telephone Companies, representing a capital stock of $1,000,000, and the local independent telephone exchanges in San Antonio, Austin, Waco, Houston and a number of smaller cities of the State are reported to have passed into the hands of the North American Telephone & Telegraph Company. These independent toll lines extend from points in Oklahoma and the Indian Territory, to San Antonio, Houston, Beaumont, Tex.; Shreveport, La; Dallas, Tex., and many other points. The amount of capital invested in these several independent companies exceeds $3,000,000.

LOGAN, UTAH.—The Rocky Mountain Bell Telephone Company has been granted a franchise to extend its lines to Mendon, Cache Junction, Newton and Clarkston.

STAUNTON, VA.—A charter has been granted to the Weyers Cave Telephone Exchange, whose capital stock is not to exceed $5,000. The following-named officers have been elected: J. B. Kegay, president; S. A. Driver, vice-president; N. L. Shreckhise, secretary; S. I. Cline, treasurer.

FOND DU LAC, WIS.—The Little Wolf Telephone Company was sold at receiver's sale on April 20 to Leander Choate, of Oshkosh, one of the bondholders, for $65,000. This amount represents the bonded indebtedness of the company, which has been in business for four years, and has a local exchange of 800 subscribers, besides over 400 miles of toll line. Creditors to the amount of $30,000, it is stated, are not provided for, and the stockholders, who had invested $80,000, get nothing.

ELECTRIC LIGHT AND POWER.

SAN DIEGO, CAL.—Press reports state that bids will be opened June 1 for an electric light plant. The city clerk may be addressed.

STOCKTON, CAL.—The City of Stockton proposes to hold a special election on May 28th to vote on the proposition to issue $160,000 bonds for the construction of a municipal electric lighting plant. This action is being opposed by lighting companies.

AZUSA, CAL.—At the annual meeting of the Azusa Electric Light & Power Company a new board of directors was elected as follows: W. J. Wade, president; T. C. Bouldin, vice-president; Ed. Mace, Charles W. Crawford, E. K. Pierce, J. W. Calvert and C. H. Lee. Ferber L. Wade was chosen secretary.

EUREKA, CAL.—It is reported that the Van Duzen Electric Power Company has completed surveys for the power system to Eureka and every point in Eel River Valley. Arrangements will be made for a plant of 2,000-hp to be established at once on the Van Duzen. Five other plants will follow, aggregating a total of 10,000-hp.

LITTLETON, COLO.—The citizens have voted to grant a franchise to Nelson Rhoades, Jr., to construct an electric light, heat and power plant.

DENVER, COLO.—The Arapahoe Electric Light & Power Company has been incorporated with a capital of $50,000. Nelson Rhoades, Arthur G. Reynolds and Wm. C. Sterne are the incorporators.

ATLANTA, GA.—A recommendation will go to the City Council of Atlanta that the municipal lighting contract shall go to the Georgia Railway and Electric Company for a period of five years. The company agreed to furnish lights at the rate of $75 per arc light per annum.

MOSCOW, IDA.—The Electric Light and Power Company at this place will increase the capacity of its plant.

REXBURG, IDA.—A power company which will utilize the falls on Snake River near this city is in process of organization.

KENDRICK, IDA.—Preliminary steps are being taken towards the re-organization of a company which proposes to install an electric light plant at the Kendrick flumes.

SILVER CITY, IDA.—The power plant installed at Swan Falls, on the Snake River, with a capacity of 8,000 horse-power is supplying light for Dewey, Silver City and Murphy, and power for numerous mills and mines now being actively operated in that district.

QUINCY, ILL.—The Quincy Gas & Electric Company has sold its plant to the J. T. Lynn Company. It is to improve the electric system. J. C. Sloan is manager.

PAXTON, ILL.—The Paxton Light, Heat & Power Company has been incorporated under the laws of New Jersey, with $75,000 cumulative preferred stock and $75,000 common stock.

CONVERSE, IND.—The Converse Electric Light Company has been incorporated to construct and install an electric light plant in this town. The capital stock is $15,000. O. P. Swengen and S. M. White are directors.

ANDERSON, IND.—The City Council has instructed the city electric commissioners to arrange for private capital to rebuild and install the light plant, with the understanding that the city can then buy it on the installment plan. This plan is made necessary in order to keep from going beyond the legal debt limit for a city. A company composed of J. J. Nelterville, C. L. Henry, C. W. Haven and J. E. May has been organized to secure control of the electric light and water plants now owned by this city. The new company will enlarge and improve the plants and install new machinery.

MISHAWAKA, IND.—The City Council has sold the city lighting plant to the Public Utility Company. This action was taken to avert foreclosure by holders of unpaid bonds. Under the deed the city resumes the right to buy back the plant after five years. The Utility company will enlarge and improve the plant and install new machinery.

LEWIS, IA.—The citizens have voted to grant Stevens Bros. a franchise for an electric light plant.

MUSCATINE, IA.—A company is about to be formed here by the business men, with a capital of $50,000, to construct an electric light plant.

CROWLEY, LA.—Electric light and water works bonds amounting to $100,000 have been sold.

NEWROADS, LA.—The City Council has granted the Safety Electric Mfg. Company, of New Orleans, a franchise for an electric light plant and water works.

IPSWICH, MASS.—The citizens have voted to appropriate $25,000 to establish a municipal electric light plant.

MANCHESTER, MASS.—At a recent town meeting it was voted to authorize the selectmen to grant locations for an underground system of electric lighting to a corporation now forming, providing the corporation give the town an option to purchase the property at any time within 5 years.

SCHOOLCRAFT, MICH.—Electric light bonds amounting to $11,450 are reported sold.

SWANZY, MICH.—The I. Stephenson Company, of Marinette, Wis., it is reported, have decided to develop the water power on Escanaba River, at Swanzy. About 1,100-hp will be generated and transmitted to Ishpeming and Negaunee.

LAKE CRYSTAL, MINN.—The citizens have voted to issue $12,000 bonds for an electric light plant.

FARIBAULT, MINN.—The Faribault Gas and Electric Company, of this city, has filed articles of incorporation. The capital stock is $250,000. The incorporators are B. W. Cowperthwaite, John Haug and E. F. Preston, of Faribault. The bulk of the stock is owned by New York parties.

NORBORNE, MO.—The Norborne Electric Light & Power Company has been incorporated to furnish light and power; capital, $10,000. Incorporators: J. L. Wilson, Jas. W. Cunningham and others.

JEFFERSON CITY, MO.—An ordinance has been introduced into the city council providing for the holding of a special election on August 4 for the purpose of voting on a proposition to bond the city in the sum of $30,000 for the construction of an electric light system, to be maintained by the city.

HELENA, MONT.—The Helena Light & Traction Company is about to commence the construction of a new sub-station.

LIVINGSTON, MONT.—C. F. Hefferlin has purchased the light plant here and will consolidate it with the Livingston Water Power Company's plant.

GREAT FALLS, MONT.—An ordinance has been passed by Council granting John D. Ryan a franchise for an electric light, heating and power plant.

GARDINER, MONT.—The Gardiner Electric Light & Water Company has been incorporated with a capital of $15,000, to establish and maintain an electric light plant and water system. Incorporators: J. C. McCartney, Lawrence Link, and others.

OSCEOLA, NEB.—This town has voted for electric street lighting.

LINCOLN, NEB.—The citizens voted to issue $65,000 bonds for a municipal electric light plant. Bonds have been ordered for sale by Council. Geo. L. Campen is city engineer.

MANCHESTER, N. H.—A contract with the Manchester Traction, Light & Power Company for lighting the city at $90 per arc light of 2,000-cp for 5 years was practically agreed upon by the Mayor and Board of Aldermen.

JERSEY CITY, N. J.—The Northern Jersey Light, Heat and Power Company, capital $100,000, has been incorporated by George Francis O'Neill, Joseph Wehrie and Thomas Boyle.

BROCTON, N. Y.—Bids will be received May 2 by G. C. Harmon, Village Clerk, for $10,000 electric light bonds.

GREENPORT, L. I., N. Y.—The citizens have voted to issue $20,000 bonds to enlarge and extend the village electric light and power plant and water works.

ALBANY, N. Y.—The Long Acre Electric Light and Power Company, of New York, capital $50,000, has been incorporated. Directors: William Harris, W. W. Walter and Frank McKee, New York.

LAURINBURG, N. C.—The town of Laurinburg has sold $10,000 worth of electric light bonds. The contract for a lighting plant has been let and work will be started at once.

COOPERSTOWN, N. D.—The Northwestern Electric Company, of Fargo, has secured a franchise for a lighting plant.

WESTWOOD, OHIO.—The village of Westwood is to be illuminated by current furnished by the Cincinnati Gas & Electric Company, and 235 lamps will be installed.

DESHLER, OHIO.—The plant of the Deshler Electric Light Company has been purchased by the Findlay National Bank. It is reported that $8,000 will be expended in improvements.

SANDUSKY, OHIO.—The Central Heating & Lighting Company, recently organized here to furnish light and power and steam heat, is seeking a location for its plant, which will be built at once.

CINCINNATI, OHIO.—The General Light, Heat & Power Company has been incorporated with $20,000 capital stock, by T. S. Spivey, W. C. Hattersley, W. E. Arnold, W. Scott and G. A. Hattersley.

BELLAIRE, OHIO.—The Bellaire Gas & Electric Company and the Belmont Electric Light & Power Company have consolidated under the name of the Bellaire Light & Power Company with a capital stock of $150,000.

BAKER CITY, ORE.—It is announced that an electric plant will be installed soon at the Sanger mine at a cost of approximately $75,000.

HEPPNER, ORE.—An electric light plant to be equipped at an estimated cost of $18,000 will be installed shortly 15 miles south of Heppner, diverting power from Willow Creek.

TILLAMOOK, ORE.—The City Council has granted C. E. Hadley a franchise to install an electric lighting system. It is proposed to get the power from north fork of Wilson River, and the plant will be put in this summer, at a cost of $10,000.

BERLIN, PA.—The citizens have voted to issue $15,000 bonds for an electric light plant.

MARION, S. C.—The H. B. Dysart Water & Electric Company has been granted a franchise at Marion to build an electric light plant. It will begin work at once.

LEWISBURG, TENN.—A new electric light plant will be erected at Lewisburg.

KNOXVILLE, TENN.—The Knoxville Power Company has filed an amendment to its charter increasing the capital to $10,000.

LOGAN, UTAH.—A decision has been rendered in regard to the $65,000 bond issue for the construction of a municipal lighting plant at this place, and the bonds will be issued.

FILLMORE, UTAH.—C. S. Pulver, of Ogden, Utah, will install an electric light plant here. Water power will be used.

CONNELL, WASH.—The Connell Land & Improvement Company has been granted a 25-year franchise to furnish the city with water, electric light, electric power and telephone systems. A franchise has also been granted for the construction of similar systems at Mesa.

ENCAMPMENT, WYO.—An electric lighting system is now in operation here, the power being generated from the South Fork of Encampment River.

CODY, WYO.—An electric light plant will be installed at the De Maris Springs and hotel here.

THE ELECTRIC RAILWAY.

FT. SMITH, ARK.—Articles of incorporation of the Fort Smith Light & Traction Company have been filed. The company is to operate an interurban electric railway across the Arkansas River, near Van Buren. The capital stock is $300,000, all of which has been subscribed.

SONORA, CAL.—The bid of Herschel F. Lamotte for a franchise to construct and operate an electric railway through the county has been accepted by the supervisors.

LOS ANGELES, CAL.—Two important franchises have been sold by the City Council to the Pacific Electric Railway Company for $7,500. They grant the privilege of a third rail for standard-gauge purposes down Main Street and enable the company's big interurban lines of the Huntington-Hillman syndicate to reach the company's $600,000 depot now building in the heart of the city.

COLORADO SPRINGS, COL.—C. L. McKesson and J. E. Little, of Colorado Springs, are interested in the plan to build an electric railway from Cripple Creek to Gillett, thence to the summit of Pike's Peak, and ultimately to Colorado Springs. F. A. Wright and W. A. Parkinson, of Gillet, are also interested in the project.

ROME, GA.—The committee on subscriptions for extending the street railway from Rome to Lindale has raised $5,000, Northern capitalists having agreed to invest $125,000 in the local electric street railway if the city of Rome, would give a bonus of $15,000.

BRAZIL, IND.—The City Council has granted a franchise to H. D. Hall and E. Adams for the use of the streets for an electric railway.

VINCENNES, IND.—The Citizens Street Railway Company, of this city, will erect a new power-house and install it with new machinery this summer.

NEW CASTLE, IND.—The City Council has granted a franchise to the Union Traction Company for a terminal of a line from Anderson to this city.

RICHMOND, IND.—The Richmond & Northwestern Electric Railway Company has been granted a franchise for an electric line through Wayne County.

VERSAILLES, IND.—The Commissioners of Ripley County have granted a franchise for the Madison, Greensburg and Indianapolis Electric line across the county.

VALPARAISO, IND.—The Union Traction Company, of Indiana, has asked the City Council for a right to pass through the city with its Logansport-Chicago line.

HARTFORD CITY, IND.—The Commissioners of Blackford County have granted the Montpelier-Warren & Portland Traction Company a franchise through the county.

MUNCIE, IND.—It is reported that a deal has been made to consolidate the Muncie, Hartford City & Ft. Wayne Traction Company and the Muncie and New Castle Traction Company.

KOKOMO, IND.—The Kokomo, Marion & Western Traction Company has filed a notice with the Secretary of State of an increase of capital stock from $10,000 to $1,000,000. The company also filed notice of a change of name from the Converse & Marion Traction Company to the Kokomo, Marion & Western Traction Company, authorized by the Howard Circuit Court. The interests in this company also filed articles of the Indiana Interurban Construction Company, of Kokomo, to "promote, finance, conduct, equip, rent and operate" street and interurban companies and plants for distribution of light, heat and power and to deal in stocks and securities of other companies. The capital stock is $20,000. The directors are O. V. Darby, H. D. Thomas, C. C. McFann, G. W. Norwood and George E. Brunner. It is the intention of the company to build a road from Kokomo to Marion, about 60 miles.

DUBUQUE, IA.—The Iowa, Illinois & Wisconsin Interurban Railroad Company has been organized, with a capital stock of $750,000, to build an electric railway from Dubuque to Platteville, Wis., a distance of 30 miles. The officers of the company are Peter Keine, of Dubuque, president; S. B. Howard, of New York, vice-president; C. H. Eighmey, of Dubuque, treasurer; Charles Peaslee, of Dubuque, secretary.

MADISONVILLE, KY.—Chicago capitalists are interested in a proposed electric railway from Madisonville to Earlington and the road is now said to be almost assured. A franchise has been applied for from the former town.

LOUISVILLE, KY.—The *Louisville Times* says that the Louisville Railway Company is to be reorganized and that two plans have been worked out for the reorganization.

NEW ORLEANS, LA.—The City Council of New Orleans has advertised for bids for the franchise of an electric railway to operate in Algiers.

SPRINGFIELD, MASS.—The Woronoco Street, Railway Company has awarded Seymour & Newell, of Springfield, the contract for the construction of the company's new line to Holyoke.

GREENFIELD, MASS.—The Greenfield, Deerfield & Northampton Street Railway Company, is having plans prepared for developing the water power at Gardner Falls. C. W. Clapp is engineer. The company has asked for authority to make an increase of $30,000 in its capital stock, making the total $150,000.

WESTFIELD, MASS.—The Woronoco Street Railway Company is planning to increase the equipment of its power house in Westfield to provide power for the operation of its line to Holyoke now being built.

PITTSFIELD, MASS.—The committee on water supply and towns of the legislature has granted the Huntington & Westfield Street Railway Company the right to dam the Westfield River for the development of power.

WORCESTER, MASS.—The Worcester & Holden Street Railway Company has under consideration a request from citizens of Rutland to build a line to that town. A proposition is being considered by other street railway men of building a line from Rutland to West Brookfield.

SPRINGFIELD, MASS.—The Railroad Commissioners have approved an issue of $1,500,000 twenty-year 4 per cent. bonds by the Springfield Street

Railway Company. Of the proceeds of this issue $1,250,000 are to be applied to fund floating debt, and $250,000 are to be used for improvements and betterments.

CUMBERLAND, MD.—The Cumberland Electric Railway Company has been granted a 25-year franchise for the construction of a number of new lines here.

LAUREL, MD.—The Laurel Traction Company has filed articles of incorporation at Annapolis. Charles J. Fox, Matthew Hanley, J. K. Lamb, of Philadelphia; Edward T. Benton, Jr., and George G. Benton, of Prince George County, Md., are interested.

CARTERSVILLE, MO.—The Southern Missouri Electric Railway Company has filed for record articles showing that it had made an increase in its capital stock from $800,000 to $1,500,000.

UTICA, N. Y.—The stockholders of the Utica & Mohawk Valley Railroad Company have voted to increase the capital stock of the company from $3,100,000 to $6,300,000.

OSSINING, N. Y.—The Westchester Traction Company has obtained from the State Railroad Commissioners approval of an increase of capital stock from $300,000 to $1,500,000.

JAMESTOWN, N. Y.—Contracts are to be awarded at once by the Chatauqua Traction Company for the construction and equipment of its proposed road between Lakewood and Mayville, a distance of 19 miles.

JAMESTOWN, N. Y.—The Jamestown, Chautauqua and Lake Erie Railroad, which runs from Jamestown to Westfield, skirting Chautauqua Lake for its entire length, is to be converted into an electric trolley line. It is owned by Eastern capitalists.

BAY SHORE, N. Y.—The South Shore Traction Company, which purchased the electric light plant at Patchogue, and has options on the plants at Islip and Amityville, has made formal application to the Islip Board of Highway Commissioners for a franchise to run an electric railway.

HAMMONDSPORT, N. Y.—F. J. Kilpatrick and John F. Tuerk, of New York, have been granted a franchise in Hammondsport. Messrs. Kilpatrick and Tuerk have in contemplation the construction of an electric railway from Hammondsport to Bath, and unofficial reports say they have secured an option on the property of the Penn Yan, Keuka Park & Branchport Electric Railway.

COLUMBUS, OHIO.—The Columbus, Marysville & Bellefontaine Railway Company has been incorporated with $25,000 capital stock, by W. H. Luchtenberg, R. O. Luchtenberg, L. J. Guthke, M. B. Earnhart and O. E. Luchtenberg.

CLEVELAND, OHIO.—The Cleveland, Painesville & Eastern Railway Company is installing a storage battery at its power house at Willoughby. The company will make a number of improvements at Willough Beach Park.

ELYRIA, OHIO.—The Elyria, La Grange & Southern Traction Company has been incorporated with a capital of $80,000, by F. H. Foster, H. J. Ely, Wm. Heldmyer, G. H. Chamberlain, W. B. Johnson, J. M. Starr, I. A. Freeman and P. K. Clark.

YOUNGSTOWN, OHIO.—The Youngstown & Southern Railway Company has placed contracts with the Westinghouse Company for its electrical equipment. It is probable that the contract for building the road will be awarded to the Philadelphia Construction Company.

CINCINNATI, OHIO.—The Cincinnati & Columbus Traction Company is having plans prepared for a large power station to be erected at Perinton, with sub-stations at Perinton, Milford, Fayetteville and Hillsboro. Philip C. Swing, Cincinnati, is at the head of the project.

MANSFIELD, OHIO.—The Mansfield Railway, Light & Power Company is planning a number of important improvements to its system. A storage battery booster outfit will probably be installed and some new cars will be purchased. The Shelby interurban line will be extended to Plymouth.

MT. VERNON, OHIO.—The promoters of the Mt. Vernon, Mt. Gilead & Western Railway Company assert that they have practically all the franchises and rights of way required, and that capital sufficient to build a portion of the road has been secured. W. C. Bennett, of Mt. Gilead, is one of the chief promoters.

CLEVELAND, OHIO.—Tucker, Anthony & Co., of Boston, are negotiating with the Pomeroys, of Cleveland, for the control of the Tuscarawas Traction Company, whose line will form a part of the through system which the Tucker, Anthony-Appleyard interests are building to connect Cleveland, Columbus and Cincinnati.

CLEVELAND, OHIO.—The Youngstown & Ohio River Railway & Light Company has been formally organized in Cleveland and the following-named officers elected: T. W. Hill, president and treasurer; Will Christy, vice-president; Max P. Goodman, secretary. The road will extend from Youngstown to Salem and later will be extended to East Liverpool. The capital stock has been increased from $10,000 to $1,500,000.

SPRINGFIELD, OHIO.—The controlling interest in the Springfield & Xenia Traction Company has been sold to the Bushnell syndicate, of Springfield, by J. R. Nutt, Will Christy, of Cleveland, and their associates. The new owners have elected the following-named officers: J. J. Fisher, president; J. E. Bushnell, vice-president; Dr. H. C. Diamond, secretary-treasurer. The road will be consolidated into the line which the Bushnell syndicate is building from Springfield to Troy and Piqua.

YORK, PA.—The York Traction Company is surveying a line from Dallastown to Glen Rock.

NANTICOKE, PA.—It is proposed to extend the People's Street Railway to Berwick, 20 miles from Nanticoke.

WAYNESBORO, PA.—Baltimore capitalists are reported to be considering the plan of building an electric railway in the vicinity of Pen Mar.

CHAMBERSBURG, PA.—The Chambersburg, Greencastle & Waynesboro Street Railway Company has appointed a committee to secure a site for a car-house and power house.

GREENVILLE, PA.—The Borough Council has granted a franchise to the Greenville & Westside Street Railway Company. The company is composed of Congressman E. Acheson, Hon. J. V. Clark, W. I. Berryman and J. W. Taylor.

UNIONTOWN, PA.—The Myersdale & Salisbury Street Railway Company, of which O. W. Kennedy is president, has commenced the construction of 8½ miles of street railway between Myersdale and Salisbury in Somerset County. The capital is $250,000.

JAMESTOWN, PA.—The Chatauqua Traction Company has organized as follows: A. N. Broadhead, president; S. B. Broadhead, vice-president and treasurer; W. R. Reynolds, secretary; George E. Maltby, general manager. The company plans to build an electric railway between Mayville and Lakewood.

DALLAS, TEX.—A party of bankers and engineers have arrived in Dallas from London, accompanied by capitalists from New York and Boston. They came with a view of investing largely in electrical properties in this and other Texas cities. Members of the party are A. E. Ginnis, of Ginnis & Mason, London; B. S. Ginnis, of Ladenburg, Thalman & Co., of New York; J. K. Newman, banker, of New York, and G. W. Bacon, engineer, of New York, and Guy E. Tripp, of Boston.

LEGAL.

LITIGATION ON TELEPHONE APPARATUS.—Injunction suits have been brought by the Kellogg Switchboard and Supply Company, of Chicago, in the United States Circuit Court, against the Stromberg-Carlson Manufacturing Company, of Rochester and Chicago, and the Louisville Home Telephone Company, of Louisville, Ky., asking that the former be restrained from infringing patent No. 718,855, granted to Kempster B. Miller, for a telephone wall set, and that the latter be restrained from infringing, by purchase and operation re-issue patents Nos. 12,031 granted to Francis W. Dunbar for a 2-wire telephone system, and 12,090 granted to William W. Dean for a 2-wire testing system.

OBITUARY.

MISS MARY A. HENRY.—News just received by friends in Washington announces the sudden death on April 10, at Seville, Spain, of Miss Mary A. Henry, eldest daughter of the late Joseph Henry, the first head of the Smithsonian Institution. Miss Henry had been engaged for several years in collecting the scientific, literary, and personal papers of her father, with whose work she was sympathetically familiar, and fortifying his claim to the discovery of the essential principle of telegraphy. Two sisters survive her. Miss Henry's death appears to have been without warning of any sort. She went to bed apparently in her usual physical condition and died before morning. Readers of *The Electrical Engineer*, one of the constituent journals of ELECTRICAL WORLD AND ENGINEER, will doubtless recall the series of admirable articles on her father's work that she contributed to its pages some years ago. She also took an active part in these columns, in the Henry-Morse-Vail controversy, a few years ago.

MR. W. F. D. CRANE.—It is with deep pain and regret that we record the death, at Orange, N. J., on April 28, of Mr. William F. D. Crane, at the home of his father, Thomas S. Crane, from typhoid pneumonia, after an illness of two weeks. He was thirty-eight years old and unmarried. He was a graduate of Cornell. He figured prominently in the development of the electric storage battery, electric motor, electric railways, etc., and though a young man had had notable success as an electrical engineer. At the time of his death he was with the American Stoker Company, of New York. Mr. Crane had been a member of the American Institute of Electrical Engineers since 1888 and was also a member of the New York Electrical Society for several years past. He contributed from time to time to the pages of this journal, and his articles were always valuable and instructive. When noting recently his illness in these columns we little expected so soon to mourn the loss of this estimable and talented young engineer.

MR. S. MORGAN SMITH.—We noted recently the death, in California, of Mr. S. Morgan Smith, and are now able to give a few interesting details about his career. He was born Feb. 1st, 1839 in Davie County, N. C., and was educated in the public schools there. Later on he attended the Moravian College at Bethlehem, Pa., from which institution he graduated in 1861. During his college course he prepared himself for the ministry and from 1861 to 1866 he was pastor of the Moravian Church at York, Pa. In 1864 he was elected Chaplain of the Two Hundredth Regiment Pennsylvania Volunteers, in which capacity he served until the end of the war. In 1866 he went to Canal Dover, O., where he had charge of a congregation for five years. Here he was forced to quit the ministerial work in 1871 on account of a serious throat affliction and he returned to York. About this time he began giving his attention to the perfecting of a washing machine, known as the "Success" which he invented and had patented. Thousands of these machines were sold in this and foreign countries. In 1875 he became interested in the manufacture of water wheels. His first wheel was known as the "Success," many of which were installed in mills and factories throughout the country. Later he placed upon the market the "Improved Success," a wheel giving more power than the "Success" of the same diameter. He found ready sale for great numbers of these wheels in this and foreign countries and many hundreds are in use driving all kinds of machinery. In 1892 he engaged in the manufacture of the "McCormick" water wheel and supplied many of the largest plants in operation in this country, Canada and foreign countries. Although the shops were small in which he started the manufacture of water wheels, they have assumed such proportions, that at the time of his death, they were among the largest and best equipped devoted exclusively to the manufacture of water wheels and power transmitting machinery. He was a member of General John Sedgwick G. A. R. Post No. 37 and for a number of years president of the Society for the Prevention of

Cruelty to Animals; President of the York County Sunday School Society, during which time he visited many conventions held under the auspices of this association throughout the county. He was a member of the Ministerial Association of York; President of the Board of elders and trustees of the Moravian Church for more than 30 years; Superintendent of the Sunday School for over 20 years; Member of the Board of Trustees of Linden Hall Seminary, Lititz, Pa.; a school director for several years; President of the Atlanta Water & Electric Power Co., as well as president of the company which bears his name. As a minister of the Moravian Church he was a close student and an eloquent orator. In his demeanor he was a man of warm disposition, kindly nature and charitable in every sense. In 1862 he married Miss Emma R. Fahs, daughter of Mr. and Mrs. John Fahs, of York, Pa. He is survived by a widow and six children—Charles Elmer, Stephen Fahs, Beauchamp Harvey, Mrs. Hugh Lee Miller, Mrs. C. E. Etnier and Miss Mary Delia Smith.

PERSONAL.

MR. FRED RECKENZAUN, F. E., has changed his consulting offices from 1 Broadway to 77 Chambers Street, New York City.

MR. W. S. ACCLES, the European manager of the Niles-Bement-Pond Company, 136 Liberty Street, New York, is now visiting the United States.

MR. I. STERNFIELD, of the Goulds Manufacturing Company, Seneca Falls, N. Y., has sailed for a business trip to Europe. He expects to be absent several months.

MR. W. H. SELDON, JR., secretary and treasurer of the Miller-Seldon Electric Company, of Detroit, Mich., was a visitor in New York City last week making various business arrangements.

MR. J. J. LOWTHIAN, representative of Baker & Company, platinum refiners, made a call at the Chicago office of ELECTRICAL WORLD AND ENGINEER recently, while on business in the West.

MR. V. H. YARNALL, the general manager of the American Vitrified Conduit Company, 170 Broadway, New York, has left for Russia to superintend laying the conduit for the St. Petersburg municipal telephone system.

MR. BASSETT JONES, JR., formerly with the Electric Storage Battery Company, has accepted a position as supervising engineer with the well-known New York City real estate firm, Douglass Robinson, Chas. S. Brown & Co.

MR. GEORGE T. HANCHETT, consulting electrical engineer, has moved his offices to the Engineering Building, 114 Liberty Street, New York City, where he proposes also to provide convenient laboratory and testing facilities.

PROF. W. D. MARKS, M. E., the well-known engineer and central station expert, of Philadelphia, has been in New York recently on important business, and renewing acquaintance with many old friends who have not seen him for a long time past.

MR. J. F. CUMMINGS, formerly of Detroit, Mich., and until recently manager of the British electrical engineering and contracting firm of Maguire & Baucus, London, has been appointed European representative of the American Vitrified Conduit Company with headquarters in London.

MR. C. H. WILMERDING, consulting engineer, and one of the past presidents of the National Electric Light Association, has removed from his old offices in La Salle Street, Chicago, to new quarters, 1100 Old Colony Building that city.

MR. J. W. HOLMAN, recently of *The Engineering and Mining Journal* and Mr. G. W. Scott, recently of the *Mining and Scientific Press* have purchased the *Western Mining World*, of Chicago, and after May 1 it will be known as the *Mining World*.

MR. R. FULLER, secretary and manager of the Fuller Company, of Detroit, Mich., spent a few days in Chicago recently looking after some important matters connected with the interests of his company, which manufactures electrical and ventilating apparatus.

MR. ANDREW CARNEGIE sailed for Scotland last week and before doing so made another gift in aid of education by placing $600,000 at the disposal of Tuskegee Institute, the Southern College for colored students, and to assist Prof. Booker T. Washington in his admirable work there.

MR. J. B. ORR, of the electrical engineering and contracting firm of James Mitchell & Company, Rio de Janiero and San Paulo, is expected to arrive in New York from the West to-day. He can be found in the Brazilian department of the American Trading Company, Broad Exchange Building. He intends to sail for Brazil, May 5.

PROF. ALEXANDER GRAHAM BELL visited Indianapolis, Ind., recently. Among other statements made by him during an interview, he is reported as saying: "I am credited with receiving royalties that make my mouth water, but I am sorry that I do not get them. The fact is," he continued, "I own just one share in the Bell Telephone Company."

MR. J. K. ROBINSON, of Iquique, Chili, who looks after the business of the Westinghouse and other allied American interests throughout Chili, Bolivia, Peru and Ecuador, is now in New York. He is making his headquarters at the offices of William E. Peck & Company, Centennial Building. He will place some substantial orders for equipment before he returns home.

SIR OLIVER LODGE, in a speech last week, said: "In the Somaliland campaign, the first war in which an organized attempt has been made to use the wireless system of telegraphy, it has not, I understand, succeeded. Yet at sea it has proved of the utmost possible convenience, and any ship which is not provided with this apparatus considers that it has a first-class grievance."

MR. EDWARD R. TAYLOR, of Penn Yan, N. Y., will sail for Europe May 12, where he will attend the meetings in Berlin of the International Congress of Applied Chemistry as a delegate of the American Electrochemical Society and of the Society of Chemical Industry. Mr. Taylor has accepted an invitation to prepare a paper for presentation before the Congress.

MR. F. H. CHAMBERLAIN, some time connected with the General Electric Company and who more recently was on the construction staff of the Sydney City & Suburban Tramway System, which is being equipped with American equipment, etc., has been appointed to draw up plans for the electrical conversion of the existing horse car system in Christchurch, New Zealand.

MR. GEORGE A. ANNABLE, lately manager of the New York office for the Cutter Company, of Philadelphia, Pa., has taken other territory for the Cutter Company, outside of the Greater New York, and has added to his line the "Yost" incandescent lamp socket, made by the Yost Electric Mfg. Company, of Toledo, O. He retains the same office as before, 120 Liberty St.

MR. FRANK J. SPRAGUE was a member of the dinner committee for the dinner given last week by the Colonial Club, of New York, in honor of Mr. Horace White, the retiring editor of the *Evening Post*. That model journal under Mr. White's management has been very liberal in its policy toward electrical matters and has taken a deep interest in the advance of electric traction.

MR. MORTIMER J. HIGLEY, formerly superintendent of the lighting department of the Burlington (Ia.) Railway & Light Company, has accepted the management of the Belvidere, Ill., Gas & Electric Company. Mr. Higley has been at Burlington seven years, where he has made a good record, and the Iowa Electrical Association will regret to lose him, as he has been one of its most helpful members.

MR. FRANK KLEPETKO, consulting electrical engineer, Maritime Building, New York, has returned from Peru, where he went in the interests of the J. B. Haggin group of capitalists, who are developing the Cerro de Pasco mines. Mr. Klepetko is now engaged in drawing up plans for the construction of a 5000-hp. hydraulic plant which is to furnish power to operate a large smelter to be built at the Peruvian mines.

MR. F. F. SAPP, of the North Electric Company, Cleveland, Ohio, accompanied by Mr. R. Hendrickson, its engineer, was a welcome caller at the offices of ELECTRICAL WORLD AND ENGINEER during the past week. Starting for pioneer work in the field of rural telephony, the North Company has gradually built up a business which includes some of the largest modern city exchanges in the country, and Mr. Sapp is now seen more frequently around twenty-story buildings than among the waving hills of corn.

MR. STEPHEN M. HALL has recently associated himself with the C. & C. Electric Company in the capacity of sales engineer, and will be stationed at the New York office. Mr. Hall is a graduate of the Massachusetts Institute of Technology, and during the several years since his graduation he has acted as chief electrician in the Norfolk Navy Yard, and has been connected with the C. W. Hunt Company and the Storey Motor & Tool Company.

MR. H. T. HARTMAN, editor of the question box for the coming convention of the National Electric Light Association, Chicago, May 26, 27, 28, has already received over two hundred answers to the preliminary list of questions sent out April 1st. Nearly every one of the 125 questions has been answerd. A supplementary list, nearly as large, has just gone to the members, and the question box this year promises to be an encyclopedia of useful knowledge for central station managers.

MR. ROBERT L. ELLIOTT, of Chicago, reporter on theft of current, has prepared an excellent report for the Chicago electric light convention, describing different ways in which electric current is stolen, showing means for detecting the guilty parties, and suggesting methods for preventing the possibility of theft. The report will also show which of the states have laws punishing this crime and what uniformity exists in the laws of the different states. It is hoped that a uniform law can soon be enacted in all the states.

MR. W. E. RUNDLE, of New York, has made several improvements in the chart which he designed for mapping an underground cable system, and which was described in these columns some time ago. It is proposed to modify the original plans so as to show overhead construction as well as underground, substituting in place of the man-hole in underground work a pole with its length, diameter at top, number of cross arms per pole, number of pins on each cross arm and the location of each wire upon each pin and also the blank pins.

MR. EDWARD D. ADAMS, the well-known banker and creator of Niagara power interests, as well as American representative of the Deutsche Bank, entertained at luncheon last week, on the day the new Stock Exchange opened, at the Midday Club, Dr. Ad. Franke, technical director of the Siemens & Halske Company. The party comprised Dr. Franke and Messrs. E. D. Adams, Wm. Stanley, C. S. Bradley, L. B. Stillwell and T. C. Martin; so that the visitor was enabled to review many aspects of electrical activity here during a very pleasant afternoon.

CHARLES D. JENNEY, president of the Jenney Electric Manufacturing Company, of Indianapolis, has perfected plans to light a baseball park by electricity so that baseball may be played at night and thus give everybody a chance to see the game. Several years ago Mr. Jenney became interested in the idea and made an experiment with strong reflectors, but the reflectors made a shadow and the players could not judge a ball when in air. Mr. Jenney's new invention is far superior to the former one, he says, and with it he can cause a diffused illumination all over the grounds, making it almost as light as day and without shadows.

MR. LYMAN T. SMITH has promised Chancellor Day to give three more buildings to Syracuse University, which, with the one he has already given, will form a quadrangle on the campus. The Smith buildings will be devoted to applied sciences. The first structure will be for electric, hydraulic and steam engineering, the second for wood-working shops and the third for forge and foundry work. The amount of money to be expended has not yet been determined, as Mr. Smith desires to wait until the close of the year to see what needs develop in connection with the present Smith College of Applied Sciences. These improvements will give Syracuse one of the largest and best equipped engineering colleges in the country.

FIELD & HINCHMAN, the well-known consulting engineers of Detroit, have incorporated under the name of Field, Hinchman & Smith, the firm of Mortimer L. Smith & Son, architects, having affiliated with them. Because of an ever-increasing business, more commodious quarters have been secured at 708-9-10 Washington Arcade Building which will be occupied by the first of May. Reversing the usual order of things, it is their intention to design complete power and industrial plants and to house these plants in suitable buildings, thus adapting the latter to the needs of the former and not vice versa. Because of important work which they are carrying on in Canada, a branch office has been established at Windsor, Ont.

Trade Notes.

THE FRANK ADAMS ELECTRIC COMPANY, of St. Louis, Mo., has increased its capital stock from $25,000 to $100,000.

THE LAWRENCE HALL ELECTRIC COMPANY, of Cincinnati, Ohio, has increased its capital stock from $20,000 to $50,000.

ANDREAS & CO. announce that on and after April 30 they will be found in their new offices at Whitehall Building, 17 Battery Place, New York City.

THE STERLING ELECTRICAL MFG. CO. was represented in New York City last week in the persons of Mr. William Coale, its treasurer and Mr. Glenn C. Webster, superintendent.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is out with a new fan catalogue listing a complete line of direct and alternating current fans. This catalogue will be mailed promptly upon application.

A. C. BECHEN, manufacturer of the Paillard non-magnetic watch so familiar to electricians, has found it necessary to seek larger quarters and is now located in the Powers Building, Monroe St. and Wabash Ave., Chicago.

THE BRODE ELECTRIC COMPANY, Los Angeles, Cal., recently incorporated, has moved into its new store at 306 So. Los Angeles Street, where it has better accommodations for its large stock of supplies. The company would be glad to hear from any concern who desires to push its business in the West.

THE ILLINOIS ELECTRIC SPECIALTY COMPANY, of Chicago, announces that it is again compelled to seek much larger quarters in order to keep pace with the demand for its I. E. S. ohmmeters, pole changers, etc. About May 1 it will remove from its present location to 171 to 173 So. Clinton St., where it will have more than double the space which it formerly occupied.

THE PROMETHEUS ELECTRIC COMPANY on May 1 moved its offices to 39 Cortlandt Street, and its factory to much larger quarters at 81 Dey Street, New York, where it has much better facilities for the production of its electric heating and cooking apparatus. Mr. Max Loewenthal is secretary of this progressive company, and he reports that there is an increasing demand for its products.

REMOVAL.—Roth Bros. & Co., Chicago, on May 1 removed to their new location and now occupy the entire building at 27 and 29 South Clinton Street. In the new quarters the firm has twice the former floor space and largely increased facilities for taking care of its rapidly increasing business. This firm, as is well-known, makes a line of dynamos and motors which have acquired an excellent reputation for efficiency and service.

PAWLING & HARNISCHFEGER, manufacturers of traveling cranes, Milwaukee, Wis., whose works were recently damaged by fire, have leased the works lately vacated by the Nordberg Mfg. Co. These shops will be in operation around May 1st and, in connection with other buildings, will place the company in better position to build cranes and hoists than prevailed before the fire. All machinery has already been purchased to equip the shops just acquired.

DUNCAN METERS.—The Duncan Electric Mfg. Co., Lafayette, Ind., has issued a handsome 28-page pamphlet devoted to the Duncan integrating wattmeter. The meter is illustrated and described in minute detail, and instructions are given for installing and testing, a number of useful tables being included under the latter head. The Electrical Material Company, Baltimore, Md., is general sales representative.

THE ELECTRICAL MATERIAL COMPANY, Baltimore, Md., which was recently appointed general sales representatives of the Duncan Electric Manufacturing Company, Lafayette, Ind., is energetically pushing the sale of Duncan recording wattmeters for direct and alternating current. The Duncan meter, it is claimed, has many advantages. In the bulletin descriptive of the Duncan meters is given a great deal of valuable information to any one with reference to various methods of testing meters.

ROSSITER, McGOVERN & CO. removed on April 28 to the Whitehall Building, 17 Battery Place, New York City. This will give them more commodious quarters and increased facilities for handling their business. In addition to the office which will be occupied by their operations, it is contemplated having an ample reception room for the use of their friends and customers, and already the Rossiter McGovern Company is contemplating the large use of this room by out-of-town visitors to make it their headquarters while in New York.

OIL FILTERS.—Among the orders recently received by the Burt Mfg. Co., Akron, Ohio, for its Cross oil filters are, one 50-gallon for a large electric light plant in Mexico City, Mex.; four large ones to be used on steamers now being built by the Eastern Shipbuilding Co.; two to be used in one of the pumping stations of the City of New York; one for the Plano works of the International Harvester Co.; the eighteenth order from the American Sheet Steel Co.; eight for San Francisco, and one to Portugal. Its agent at Mexico has just ordered sixteen, and reports business good.

McCREARY SPECIALTIES.—Since the first of the year the McCreary Electric Company, 136 Liberty St., New York, has had a very gratifying increase in sales, in fact over 60 per cent. over the same period last year. Recent export orders have been shipped to England, Mexico and China. Its "Amal" brilliant decorating stands and cup reflectors are now fitted with shade holders and conform to all requirements of fire underwriters. The company will bring out for the Fall trade several new electrical specialties, among them a new brilliant, non-tarnishing headlight reflector and several styles of car reflectors.

THE GOUDEY-McLEAN COMPANY, engineer, announces that from May 1st, 1903, its offices will be located at 120 Liberty Street, New York City. With increased capital and facilities the company will continue to operate as the foreign department of American manufacturers, syndicating the export interests of many well-known firms. It also acts as agent for the distribution and sale of electrical apparatus and material in both the export and domestic branches. The officers for the ensuing year will be Robert McLean, president; Edward E. Goudey, vice-president and general manager; Laurence W. Miller, secretary, and William D. Vanderbilt, treasurer.

THE ELECTRIC STORAGE BATTERY CO., of Philadelphia, manufacturer of the Exide battery for electric vehicles, has recently placed on the market a new battery for sparking purposes. The great increase in the use of gasoline vehicles has convinced the company that a reliable sparking battery, which will furnish a "fat and hot" spark will be greatly appreciated. The company has placed on the market a number of sizes, which are found fully described in a pamphlet recently issued by the company, giving capacities, weights and dimensions of the different types. A copy of this will be forwarded upon application to the Electric Storage Battery Co. at any of their sales offices.

ALBERT & J. M. ANDERSON CO.—The stockholders of the Albert & J. M. Anderson Manufacturing Company, a Massachusetts corporation, believing it to be for their advantage so to do, on March 27, 1903, caused to be organized the Albert & J. M. Anderson Manufacturing Company under the laws of Maine, and on April 25 the Massachusetts corporation, by unanimous vote of its stockholders sold, assigned and transferred all of its business and assets to the new company so organized in Maine. The new company has the same officers and stockholders as the old and will take over and carry on its business assuming all its outstanding liabilities at the date of the transfer, April 25th, 1903, and carrying on business at the same location and with the same facilities.

YACHT LIGHTING.—The use of storage batteries for lighting private yachts is rapidly increasing, so much so, that practically every steam yacht of modern construction now includes a battery of accumulators in its equipment. The great advantage of a storage battery lies in the fact that it enables the lights to be used throughout the night while the machinery is shut down, thus avoiding the annoying vibration from the running of a generator which is especially noticeable in a yacht while lying at anchor. The Electric Storage Battery Co. has recently contracted for the installation of five yacht lighting plants on boats now under construction at Morris Heights, N. Y., thus adding to the large number of boats already equipped with its Chloride accumulators.

THE STROMBERG-CARLSON TELEPHONE MFG. CO., of Rochester, N. Y., and Chicago, Ill., reports that it has begun the erection of a second factory in Rochester, which will be engaged in the manufacture of telephones. The plans call for a factory having two hundred thousand feet of floor space and capable of turning out two thousand telephones per day. The company also reports having just secured the contract from the Home Telephone Company, Kansas City, Mo., for six thousand five hundred central energy telephones. The Stromberg-Carlson Company has also recently sold switchboards and equipments to the following companies: Local Telephone Company, Crestline, Ohio; Harrisonville Telephone Company, Harrisonville, Ohio; Foster and Faber, Summerfield, Ohio. It has also recently sold switchboards and complete exchange equipments at the following points; Troy, Mo., Orrick, Mo., and Gillman City, Mo.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED APRIL 21, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

725,224. INDUCTION MOTOR; Abe L. Cushman, Concord, N. H. App. filed July 8, 1902. The secondary winding is made up of elements of low specific resistance and means are provided for forming a closed induced circuit from a part only of said element, so as to decrease the current induced in the secondary at starting; additional elements are brought into action as the motor speeds up. (Issued April 14.)

725,663. ELECTRICAL RESISTANCE DEVICE OR HEATER; Johann F. Bolling, Frankfort-Bockenheim-on-the-Main, Germany. App. filed April 4, 1902. A resistance material is spread upon a sheet of mica and confined by a non-conducting plate.

725,664. OUTLET BOX FOR INTERIOR CONDUITS; William F. Bossert, Utica, N. Y. App. filed March 19, 1902. Details.

725,667. TROLLEY POLE; Charles A. Bray and Florien C. Fry, Schenectady, N. Y. App. filed Sept. 17, 1902. The pole has a bend in it and is pivoted on top of the car; the wheel can make contact with a wire suspended either above the car or to one side at the level of the car roof.

725,675. DRIVING MECHANISM FOR SELF PROPELLED VEHICLES; Patrick J. Collins, Scranton, Pa. App. filed Aug. 29, 1902. A field frame contains a central space for a generator armature and two side spaces for motor armatures, the latter armatures being geared to the wheels of the vehicle.

725,681. METHOD OF CONTROLLING INDUCTION MOTORS; Harry Phillips Davis, Pittsburg, Pa. App. filed Dec. 26, 1901. (See Current News and Notes.)

725,692. REGULATOR; James B. Foote, Jackson, Mich. App. filed July 23, 1901. The object is to check the regulating movement as soon as the proper regulating effect has been produced, without permitting it to pass through a series of oscillations or decreasing amplitude about the desired point.

725,703. ELECTRIC LAMP GLOWER AND METHOD OF ATTACHING TERMINAL WIRES THERETO; Marshall W. Hanks, Pittsburg, Pa. App. filed Oct. 31, 1902. Terminal wires are wound around the ends of the glower and alloying material applied thereto by means of the high degree of heat.

725,708. ELECTRIC METER; Frank Holden, London, Eng. App. filed Oct. 23, 1901. (See Current News and Notes.)

725,719. TROLLEY STAND; Geo. E. Johnson, Pinners, Va. App. filed June 26, 1902. Details.

725,730. CONTROLLER; John B. Linn, Schenectady, N. Y. App. filed Aug. 4, 1902. Details of construction of the reversing switch.

725,731. CATAPHORIC ELECTRODE; Samuel H. Linn, Rochester, N. Y. App. filed Aug. 9, 1901. An anode of absorbent material and means for forcing an electrolyte through the same, under pressure, and against the surface or tissues undergoing treatment.

725,754. ELECTRIC HEADLIGHT; John A. Mosher, Chicago, Ill. App. filed June 17, 1902. Both incandescent and arc lights are contained in the casing, the former used in city limits and the latter in the country districts; an automatic switch provides for the cutting in of one lamp when the other fails.

725,765. VOLT AMPERE METER; Louis M. Pignolet, Orange, N. J. App. filed Sept. 27, 1901. A manual device is employed to stop the needle from swinging when the current is turned on.

725,767. SYSTEM OF CONTROL FOR ELECTRICALLY PROPELLED VEHICLES; Wm. B. Potter, Schenectady, N. Y. App. filed July 22, 1898. In a multiple unit system, the motors are automatically transformed into generators in case the conductor between cars is broken.

725,773. ROTATING FIELD MAGNET FOR ALTERNATING CURRENT GENERATORS; Henry G. Reist, Schenectady, N. Y. App. filed Oct. 18, 1901. A spider having a laminated rim body and a cast rim flange extending beyond said body to afford material for truing up without the necessity of facing off the rim body.

725,776. ELECTRIC MOTOR SEWING MACHINE TRANSMITTER; Julius Rosenberger, New York, N. Y. App. filed Oct. 14, 1902. The switch, rheostat and brake are controlled from the treadle.

725,777. SYSTEM OF ELECTRICAL DISTRIBUTION; Norman Rowe, Wilkinsburg, Pa. App. filed June 18, 1897. (See Current News and Notes.)

725,798. MULTIPLE-RATE METER; Elihu Thomson, Swampscott, Mass., and Frank P. Cox, Lynn, Mass. App. filed Feb. 25, 1899. (See Current News and Notes.)

725,799. AUTOMATIC POTENTIAL REGULATOR FOR DYNAMOS; Allen A. Tirrill, Laconia, N. H. App. filed April 13, 1900. This patent together with 725,800 and 726,234, relates to methods and apparatus for regulating the voltage of dynamos by exciting the field of the machine, controlling the excitation in response to the voltage at the regulated point, and causing the excitation voltage to react upon the control independently of its action through the fields of the machine and of the exciter.

725,800. AUTOMATIC POTENTIAL REGULATOR; Allen A. Tirrill, Concord, N. H. App. filed Dec. 16, 1901. (See preceding patent.)

725,803. APPARATUS FOR PURIFYING, STERILIZING, OR AGING LIQUIDS; Robert C. Turner, Columbus, Ohio. App. filed May 29, 1902. The apparatus consists of several tanks into which the liquid is successively introduced and electrolyzed.

725,826. ELECTRIC CURRENT SHUNTING DEVICE; Edward R. Cliff, New York, N. Y. App. filed March 22, 1902. An automatic shunting device for lamps, consisting of a paper strip adapted to be perforated under abnormal conditions, the strip being coiled upon spools and together with the various contact devices, located in a weather-proof casing through the wall of which a key shaft projects for moving the strip.

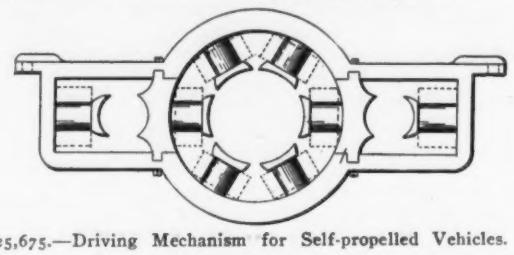
725,864. APPARATUS FOR THE TREATMENT OF GOLD OR OTHER ORES; Wm. B. McPherson, Los Angeles, Cal. App. filed Nov. 28, 1902. The charge of ore introduced into the apparatus is kept continuously agitated and moved in cycles until all the metal sought to be extracted has been removed.

725,968. PLASTIC COMPOUND; Oliver T. Hungerford, Brooklyn, N. Y. App. filed May 21, 1900. A plastic compound for use as an insulator, composed of a siliceous base, a binder and rosin oil.

725,985. ELECTROMAGNETIC BRAKE; Frank C. Newell, Wilkinsburg, Pa. App. filed Dec. 16, 1899. The braking force of the several shoes on the track is controlled by a suitable switch.

725,992. ELECTRIC LIGHTER; Wm. Roche, Jersey City, N. J. App. filed April 18, 1902. A cigar lighter in which a platinum foil wet with alcohol is brought to incandescence by pushing a button.

725,998. ELECTROLYTIC SEPARATION OF COPPER AND NICKEL FROM MATTES OR ORES; Ernst A. Sjostedt and Joseph H. James, Sault Ste. Marie, Canada. App. filed Sept. 20, 1901. A description of this process is best obtained from a copy of the patent.



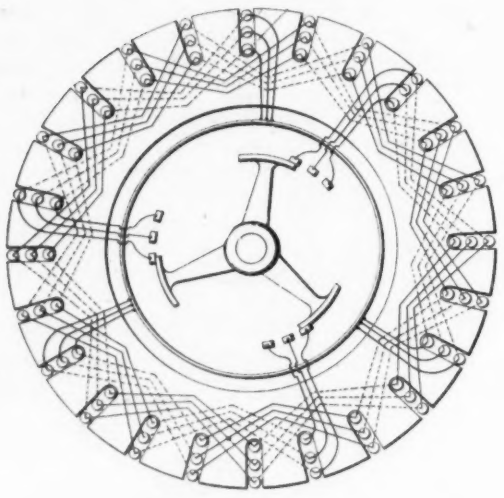
725,675.—Driving Mechanism for Self-propelled Vehicles.

726,044. X-RAY TUBE; Theodor Friedlander, Chicago, Ill. App. filed July 15, 1902. The cathode is sealed into a water chamber which extends obliquely into the tube. The water prevents undue heating of the terminal.

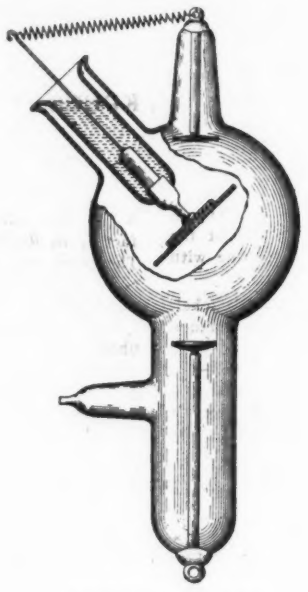
726,061. SAFETY DEVICE FOR AUTOMATICALLY PREVENTING ACCIDENTS FROM TROLLEY WIRES; Wm. A. Heyes and Lancelot O. Heyes, Wigan, England. App. filed Jan. 3, 1902. The sagging or falling of the trolley wire automatically closes a circuit to ground the wire.

726,124. ELECTRIC INCANDESCENT LAMP AND CIRCUITS AND CONDUCTORS THEREFOR; Gustave Weissmann, Paris, France. App. filed Aug. 16, 1902. The terminal wires of the lamps are bent into hooks which engage the distribution conductors to support the lamp for decorative purposes.

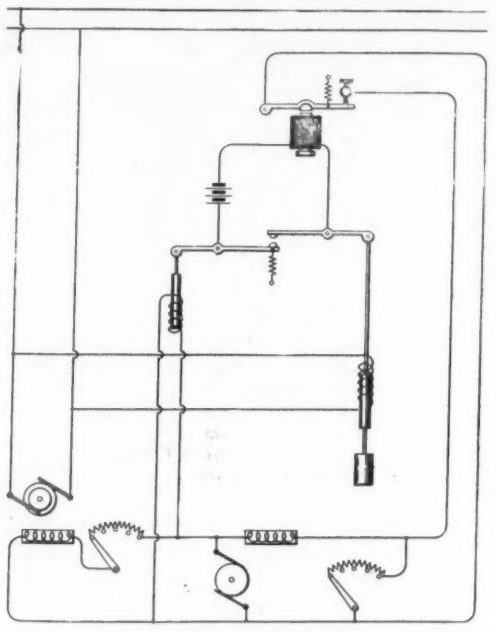
726,147. SUPPORT FOR COILED WIRE; Kern Dodge, Philadelphia, Pa. App. filed Feb. 21, 1903. A support for coiled wire capable of contracting or expanding with the wire, to hold the wire in proper position under all conditions.



725,224.—Induction Motor.



726,044.—X-Ray Tube.



726,234.—Automatic Potential Regulator.

726,177. ELECTRIC MOTOR OR ENGINE; John Massey, Anderson, Ind. App. filed Dec. 2, 1901. Details.

726,211. TROLLEY; Wm. H. Bachtel, Canton, Ohio. App. filed March 10, 1903. A vertical pole having a horizontal loop the bend of which is a spring.

726,225. MECHANISM FOR CUTTING, CRUSHING, AND DISLODGING ICE OR SLEET ON THE THIRD RAIL OF ELECTRIC RAILROADS; Henry Klein, Hoboken, N. J. App. filed Feb. 17, 1903. A serrated wheel adapted to be thrown down against the contact surface of the third rail to remove ice therefrom.

726,233. MULTIPLE-RATE METERING; Elihu Thomson, Swampscott, Mass., and Frank P. Cox, Lynn, Mass. App. filed Feb. 25, 1899. (See Current News and Notes.)

726,234. AUTOMATIC POTENTIAL REGULATOR; Allen A. Tirrill, Schenectady, N. Y. App. filed Dec. 16, 1901. (See 725,799.)